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In This Issue

Contributors

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JOHN W. SHEERES

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THE MINING CONGRESS JOURNAL

FEBRUARY, 1926

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FEATURE ARTICLES

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NEWS

NEWS—Continued

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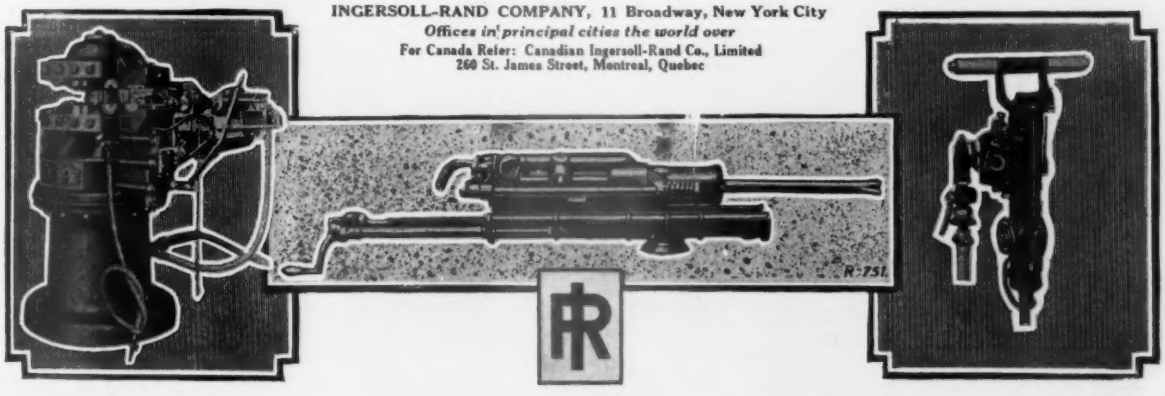

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Ingersoll-Rand

The town of the Bertha-Consumers Company

Miners' children enjoying the playground equipment

Modern types of houses at the Bertha Consumers mines

How Does the COAL MINER Live ?

IN a series of dangerous propaganda based upon less than half a truth the public has been educated to the belief that coal mine workers are the most benighted of our citizens.

What Really Are The Facts

These illustrations show conditions that are typical of many of the mining camps. The policy of this company, the Bertha Consumers Company, is to do everything possible to make working and living conditions better for the men who work with them. Their first aim is safety for their workmen and then to improve the miners' homes. To make for their contentment, the employes and the families are also furnished with schools, clubs, churches and play grounds. And it is seldom that there is an empty house on the properties.

G-E 600 h.p. station pump motor on the 1000 ft. level, Penrose shaft, Down Town Mines Co., Leadville, Colo.

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G-E mine pump Motors withstand severest wet mine conditions

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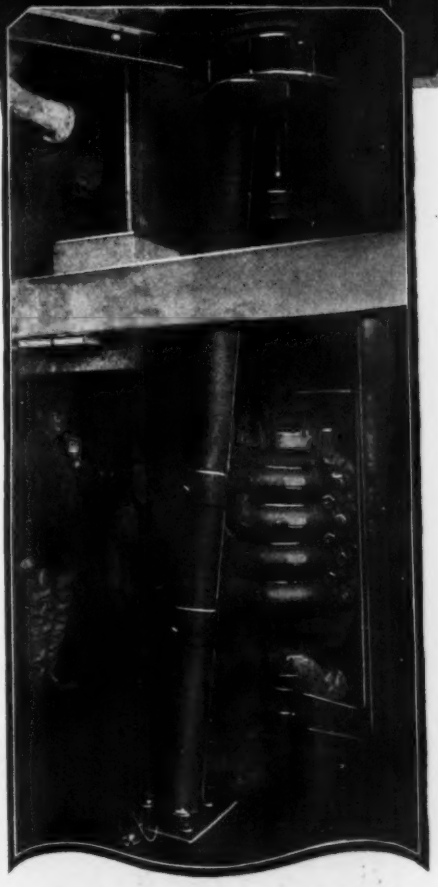

For un-watering the Penrose shaft of the Down Town Mines Co., Leadville, Colo., there are four G-E 300 h.p. vertical induction motors used as sinkers.

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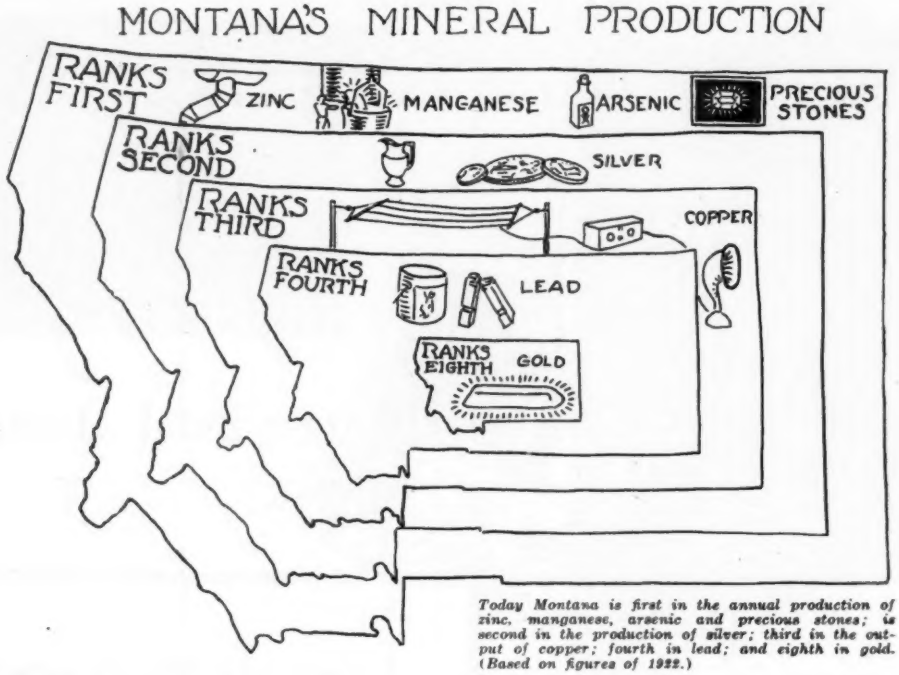
GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN ALL LARGE CITIES



Today Montana is first in the annual production of zinc, manganese, arsenic and precious stones; is second in the production of silver; third in the output of copper; fourth in lead; and eighth in gold. (Based on figures of 1922.)

A Treasure State

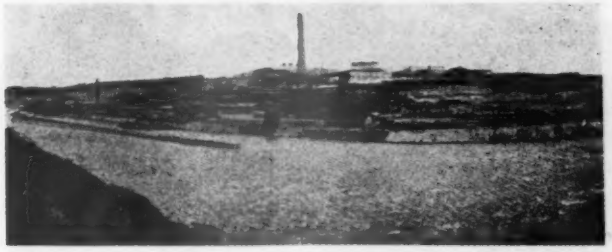
During successive periods since its first mineral discovery in 1862, Montana has led all the states in gold, silver, copper or zinc production.

The mines of Butte alone have given to the world more copper and more silver than any other district on earth; one-third of all the copper mined in the United States and one-sixth of the world's copper production to date. Her present annual production is about 225,000,000 pounds.

This state has produced more than $350,000,000 worth of silver, the largest output being that of 1918, which amounted to $16,797,479.

In round figures, Montana has yielded more than two billion dollars in mineral wealth.

Unlike the other metals, Montana's production of lead is not confined chiefly to Butte. The state's annual output of 37,000,000 pounds is gathered from widely scattered areas, whose combined yield places Montana in fourth place among the states producing this metal.



Anaconda Plant at Great Falls, Montana

Within the last ten years Montana initiated and brought to rapid development the fourth stage in her mineral history—that of zinc. Butte Hill was long known to contain important deposits of zinc ores, but they were so refractory as to be regarded more of a liability than an asset. After many years continuous work the metallurgists of the Anaconda Company, in 1916, devised an electrolytic process whereby the ores could not only be reduced on a satisfactory basis but the resultant grade zinc known to commerce—99.9 percent pure. Seven million dollars were expended by the company before this process was evolved, but today Montana's production of electrolytic zinc is around 160,000,000 pounds a year, putting her in first place among the zinc-producing states.

Fifty out of Montana's fifty-four counties yield coal in commercial quantities. Of all the lignite coal in the country, the U. S. Geological Survey reports that Montana contains 381,000,000,000 tons, or more than one-third of the nation's total.

Montana contains the nation's "greatest, best developed and most available domestic reserves of high-grade manganese ore," whose importance came to light during the World War.

According to figures prepared by the Montana Power Company, this state has a gross production record as follows:

Copper	$1,213,600,000
Silver	347,399,591
Gold	189,308,840
Zinc	126,156,448
Coal	115,709,645
Lead	10,487,264
Manganese	8,732,130
Precious Stones	2,200,000

MONTANA

The MINING CONGRESS JOURNAL

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GREATER TAX REDUCTION POSSIBLE

DURING the hearings before the Committee on Ways and Means, Secretary Mellon stated that the surplus for 1926 would be around $290,000,000. Since that statement was made, the Department of Commerce has issued its "Survey of Current Business" for December, 1925. This document shows there was a greater increased volume of business in this country during 1925 as compared with 1924. As the cost of conducting a business usually does not increase in proportion with an increased volume of business, conditions would indicate that the income tax returns for the year 1925 will show a marked increase in the taxable earnings of corporations.

The figures given in the Department of Commerce Survey therefore indicate that the surplus for 1926 will be in the neighborhood of $500,000,000, and this means that Congress can eliminate the capital stock tax, the stamp tax, and some remaining nuisance taxes, if it desires to do so, without endangering the financial structure of the Nation. The Senate Committee on Finance voted to repeal the capital stock tax, but proposes to add 1 percent on the corporation income tax to make up the estimated loss in revenue.

If the statistics by the Department of Commerce are correct and if the trend of business conditions shown by the Department's bulletins can be relied upon, the additional revenue from the income tax by reason of increased earnings of corporations will more than offset the loss of the capital stock tax, and no addition to the corporation rate will be necessary. It is the duty of Congress to consider this situation very carefully before passing the increased corporation rate.

The repeal of the capital stock tax would be a very helpful change in the law even if an increase of 1 percent in the corporation rate becomes necessary. The capital stock tax is a tax which is cumulative year by year on the properties and ore reserves of the mining industry. The same is true in the case of other natural resources.

The mining industry at the present time heads the list of industries of the country in the payment of taxes. Agriculture comes next, but the differential between agriculture and mining is startling. Statistics of Income published by the Bureau of Internal Revenue show that in the mining industry the percentage to net profits of Federal income taxes amounts to 22.07 percent; of all other taxes, 71.18 percent; and of total taxes, 93.25 percent; while in agriculture the percentage to net profits of Federal income taxes is 15.00 percent; of all other taxes, 29.20 percent; and of total taxes, 44.25 percent.

The Government's statistics show that the discrimination against the mining industry in state and local taxation is acute. The Federal government should not add anything to the burden. The repeal of the capital stock tax will result in a large saving to the industry due to the elimination of the annual expense incident to the filing of capital stock tax returns and to maintaining a complicated accounting system to meet the Government's requirements in executing capital returns on a fiscal year basis, and income returns on a calendar year basis.

This is a tax reduction bill, a tax reduction Congress, and a tax reduction year. There is no reason or excuse for increasing taxes on any class of taxpayers. If conclusions based upon Department of Commerce figures are correct, the addition of one percent on the corporation rate would have the effect of exacting from corporations probably more than double the amount of revenue raised by the capital stock tax, whereas the present rate of 12½ percent, applied against increased incomes for 1925, should be sufficient.

FINANCING COMPETITIVE INDUSTRIES

RECENTLY American bankers refused to finance a $50,000,000 loan to the German potash monopoly, thereby establishing a precedent that should be firmly maintained. It is understood that objections were based on the theory that American financial assistance should not be given to foreign industries which have a virtual monopoly of production and which might, by utilizing the funds, maintain high prices, or entirely close a market.

This action, closely following the refusal of a $30,000,000 coffee financing in Sao Paulo, Brazil, and the cold reception which British rubber producers met when attempting to effect a loan in the United States, should be incontrovertible evidence that the United States believes in a protective tariff for the encouragement of growing industries and the development of natural resources, and any attempts to nullify that tariff, either by granting reduced ocean-rail rates on imported raw materials, or by subsidizing competitive industries with American capital in countries operating on a low wage scale, will be met squarely by the refusal of the State Department cooperating with American bankers, to become a party to such a destructive policy.

Abraham Lincoln once gave an interesting argument in favor of a protective tariff. He was being urged to buy the rails for our transcontinental railroads in Great Britain because she could furnish them at a cheaper rate. But he said, "If we buy our rails in England, she has the money and we have the rails; if we buy our rails here, we have the rails and we keep our money."

Whether it is potash or rails, an industry that is striving to become a producer needs the aid of its government and protection against cheap foreign production.

MINING ON THE UP-GRADE

SENATOR SMOOT of Utah, in a notable article in the December issue of this Journal, showed the importance of the protective tariff in stimulating the revival of the mining industry. The United States Geological Survey just has issued its annual estimates on mineral production. In its report on the output of the State of Colorado, it said "mines have been opened during 1925 that have been closed from two years to twenty years." With a tariff on lead and other minerals that justifies the opening up of old producers, Colorado is again taking her place in the sun. And this applies to every other state where the tariff reaches mineral production.

The gold industry has suffered because of the fixed price for its products, both gold and silver showing a decline; but lead, zinc, iron and many non-metallic minerals show a decidedly increased production, with accompanying prosperous communities. Copper production was the greatest in any peace-time period and equalled 1918 war-period peak production. Producers of this metal were inclined to volume production at smaller net profit. While the value of the product was not so great, the copper industry was busy and prosperous.

It is highly important to the western states that this situation surrounding its mineral industries be maintained. The West suffers tremendously when its mineral production falls off, and it should see to it that the mining industry, which is its chief source of wealth, shall not only be given an opportunity to expand in every legitimate way but that it shall have the encouragement of the state and national governments, to whom it is so large a contributor.

INVESTIGATION EPIDEMICS

THAT the country generally is sick of the epidemic of investigation that has burdened the last few sessions of Congress is quite evident. Hundreds of thousands of dollars are being spent annually for the purpose of investigations that usually lead nowhere. Take the Couzens Committee report covering investigation of the Internal Revenue Department at a cost of several hundred thousand dollars and severe hardship upon taxpayers due to the slowing up of the administrative machinery of the department. The committee itself recognizes that its work has been purposeless in so far as disclosing any fraud or general maladministration is concerned. And there was the report of the Coal Commission. Is its long period of investigation with an expenditure of more than half a million dollars of any concrete value now in the crisis of the coal industry and the public it was thought to serve? Committees are now planning to investigate the Federal Trade Commission, the United States Tariff Commission and the Federal Reserve Board, and a dozen other things. The duty of the Congress is not that of an investigating body. Its function involves statesmanship. It is supposed to enter into the realm of political economy. The true function of the government is "to deliver to its citizens protection and justice; protection against foreign aggression; preservation of peace and regulation of commerce between the states; maintenance of a stable and elastic circulating medium, and the enforcement of the decrees of the courts."

When Congress hasn't the investigating fever it is afflicted with a regulation fever. The debate on the floor of the Senate regarding the anthracite coal strike shows a woeful lack of appreciation of the fundamentals that surround "life, liberty and the pursuit of happiness" from those to whom the people have a right to look for constructive help.

If Congress has no more constructive work to do than to investigate this, that and the other thing; than to harrass business and to meddle endlessly with experiments that can be of little service to the people, it should recess indefinitely until it does find constructive issues to work with. These investigations by Congressional committees that have proved so futile occupy a vast amount of time and to these committees are frequently assigned some of the most capable men in Congress, whose time if applied constructively would be of real service to the nation.

Congress may investigate. But the investigations should have some merit and not be largely for the purpose of political aggrandizement of, or newspaper publicity for some member of Congress.

THE REPORT IS IN

THE Senate Committee on investigation of the Bureau of Internal Revenue at last has submitted its report to the Senate. The report is not constructive but is not particularly damaging. After nearly two years of investigation, during which reams of testimony were taken, dozens of witnesses heard, and thousands of cases investigated, the report states that it is not deemed advisable that this committee finally commit itself to any definite legislative proposals. The report is replete with misstatements of facts and erroneous conclusions. But how could the result be otherwise when the investigation was started upon premises that were in the main fallacious.

The nature of the report bears out the predictions and justifies the criticisms concerning the investigation made heretofore in the editorial columns of this Journal. It may be that members of the Senate Finance Committee, with a high purpose and constructive zeal to actuate their efforts, may sift the conglomeration of conflicting testimony and misleading reports and from them develop ideas that will bring about helpful changes in the Federal revenue administration. It may be that the Senate Finance Committee will refer it all to the proposed joint commission on taxation now provided for in the pending revenue bill. In either case the taxpayers of the country may feel secure against injustice.

AT CINCINNATI IN 1926

THE first announcement that the Annual Convention of Coal Operating Officials and the Exposition of Mining Equipment would again be held at Cincinnati, Ohio, during the week of May 24, has evoked an unusual amount of enthusiasm and interest on the part of both operating men and manufacturers of equipment. Music Hall will again house the convention and exposition. Two weeks after space in the exposition was offered for sale more than 80 percent was contracted for. The program committee is being formed, and operating men have already submitted a list of subjects for discussion at the meeting that are highly pertinent and assure an unusually interesting session. Keep the dates in mind. May 24 to 29, inclusive. At Cincinnati.

THE COST OF STRIKES

THE strike in the anthracite industry has caused the statisticians to sharpen their pencils and to figure the cost in dollars and cents of this industrial war. Their figures make an imposing exhibit. Roughly speaking, the labor cost of anthracite production is $4.50 a ton, on the average. In round numbers, the strike has caused the failure to produce 25,000,000 tons. Translating both round figures into a round sum, the statisticians say that the loss in wages to the men is, easily, $100,000,000. On the same basis, the statisticians have computed what the operators have actually spent for the maintenance of their properties in good condition while idle and what they have paid to keep their organizations together, with nothing for those organizations to do. They have lumped this into a conservative figure of another $50,000,000. Therefore, in conservative round numbers, the statisticians make out a fairly good case when they say that the cost, in cash, of this strike has been at least $150,000,000.

The danger is that this will be considered as a total cost. As a matter of fact, it is but the beginning, if we appraise the whole situation. It must be remembered that while production from one district is shut down by a strike, the consumption goes ahead just the same. Therefore, if one group of mines does not produce the coal, another group must do it. The Jacksonville scale put the union bituminous operators in a position where most of them could not compete with the nonunion coal. Therefore, many union bituminous mines shut down for the period of the Jacksonville scale. That stopped their production, but did not stop the consumption that they formerly had supplied. That consumption had to be taken care of by other mines. That meant the building up of the nonunion mines.

We now have a suspension of anthracite production but a continuance of anthracite consumption. Therefore, we have a need further to build up the number of union mines to supply that market.

Sooner or later, the anthracite mines will, of course, resume. Sooner or later, the union bituminous field will be in a competitive position. Then all of those operators will go out and try to regain their markets just when the nonunion mines, that have been enlarged to satisfy both the trades, will be appealing for business to keep their enlarged mines going. That must mean a competitive struggle of the bitterest kind. Competitive struggles always express themselves in price reductions to the point of a sacrifice of profits. We must add the cost of this impending commercial battle to the cost of strikes.

Also, people who have been familiar with one kind of coal have, perforce, used another kind. That has caused the rebuilding or revamping of thousands of household and industrial furnaces. All of those things have cost money. In some instances mere changes in houses have required the installation of new burning equipment costing several hundred and, in some cases, as much as a thousand dollars. The sum total of those expenditures must be added to the cost of strikes.

The railroads had been hauling anthracite and union bituminous coal over relatively short distances to nearby markets. When those mines were shut down and the people bought their coal from more distant mines, the railroads had to revamp their whole arrangement and haul coal a greater distance at a higher freight rate. That cost to the railroads of a longer haul meant a greater cost to the consumers. So that freight rate has to be added to the cost of strikes.

The loss and recapture of markets involves a great campaign expense—advertising and salesmen. That expense, also, must be added to the cost of strikes.

When you come to the point of it, about the most costly thing that this country ever indulged in is a strike, such as is in progress in the anthracite field. And all that was involved, at the outside, was a 10 percent increase in the wages of the men. They went to war to win $125,000,000 a year. They have cost the nation more than a billion dollars in less than five months.

A DELICATE ADJUSTMENT

IT IS interesting to watch the play of the average mind upon the disagreement between the anthracite operators and miners. It is now obvious that this is a trial by force. The miners wanted something which the operators could not grant because the public has refused to reimburse them and because they lacked resources of their own out of which to grant the demands. This caused an impasse which the miners have tried to remove by force. The miners' union tried to force the operators to yield and, therefore, the public to pay. The union then tried to force the railroads to surrender part of their freight rates. Finally, the union tried to force the Federal Government to grant their demands in the name of the consumers—assuming that the public would consent to any bargain thus made in their name by the Government. There has been universal condemnation of this resort to force. Everywhere men are saying that force should be surrendered and that resort should be had to arbitration of the disputed points.

And yet, when this same question is attacked in a public discussion, with an eye to possible public action, the first suggestion is that force shall be employed. Thus we get such suggestions as that the Government shall seize the mines. Seize is a force word. To operate mines under seizure is to employ force. Those who do not want to go quite so far suggest that we should have compulsory arbitration. Compulsion is force. And those who graduate down to mildness would put against the men who act arbitrarily the force of public opinion. It seems that we can not, as yet, get away from the idea of opposing force with force. We are prone to condemn the use of force by the other fellow, but we reserve to ourselves the use of force if necessary to carry out our own purposes.

The plain fact is that the employment of force by the miners against society is wrong. And about the greatest danger to liberty which could be devised would be for society to develop a usable force to be employed against the miners. What we condemn in the miners is not made right by the fact that it is employed by the Government. If there are any degrees of wrong, it is less wrong for the miners to use force against society than it is for society to use force against the miners. The difference is that if the miners organize to use force, the people have an avenue of escape; they can employ others who are not members of the union. But if the Government uses—and has power to use—force against the miners, it has the power to enslave the whole population. In one instance it is a case of Ajax trying to defy the lightning. In the other, it is a matter of a Government abandoning one of the most sacred principles ever won from an oppressive autocracy.

We are of opinion that the substitute for force on either or both sides is some new sort of a deal between capital and labor. What is in dispute in all of these cases is the compensation of men for their effort. At present that is arrived at by a rule of thumbs, which

is rather an old fashioned and somewhat arbitrary way of dealing. It even has come to confine itself to compensation, without any exact understanding that the worker shall make any particular effort to earn the money. What we need is a new form of measuring the compensation for the effort. And that is, in turn, a mere matter of thinking the problem through. Because we hesitate over the difficult job of thinking the problem through is no justification for the employment of force on either side.

POOR ALASKA!

IF AN ATTEMPT should be made to set aside the State of Colorado, for instance, as a convenient region for government experimentation and a place to try out half-baked communistic doctrines, there would be a hue and cry heard from Seattle to Tampa, and from Los Angeles to Bangor!

But Alaska! It is three thousands miles away from the centers of population. If people think about it at all, the majority of them think of it as a very romantic place where gold may be swept up in buckets, or where a glare of snow and ice freezes to the marrow-bone. But Alaska is as much a part of the United States as is Colorado. It is richer in its mineral resources than many of our highly mineralized western areas. It has vast agricultural regions where produce grows in magnificent profusion.

But with all its mineral wealth, with all its splendid pioneer opportunities, it remains a wilderness. Its white population has decreased alarmingly, its mines are not producing, its agricultural industries are dying. What is wrong? The annual report of the U. S. Geological Survey, in particular reference to Alaska, sheds some light. It says, "There are large areas in Alaska that have not been adequately prospected, and many promising properties lie idle because of the lack of capital. The shortage of enterprising prospectors is a serious drawback. * * * The output of coal shows a considerable decrease."

Alaska is the land of government experimentation. In Alaska are being tried out, at an alarming cost to the people of the states, a "government-owned" railroad, and a leasing policy for minerals including the "leasing of coal lands" and the consequent decline in production. The capital that should go into the development of this great territory is probably reposing peacefully in tax-exempt bonds. A few years ago capital undertook to develop this territory, only to earn the name of profiteers and to be branded as knaves and exploiters of our natural resources. They were indicted as criminals, although in every case the Supreme Court ruled that there was no ground for the indictments.

Since the Roosevelt "withdrawal," Alaska has been the heaven of theorists. It has suffered accordingly. Surely the time is near when she will be given the same opportunity as our states have had to develop her industries through private enterprise.

The hazard in mining is great, the cost of bringing a mine to the producing stage is enormous, and no sensible business organization or business man will invest great sums of money without an even gamble on sufficient profits to recompense for the risk he assumes. If the government will take its heavy hand off Alaska, it will be but a short period of time when she will be a great contributor to our wealth, happiness and comfort, for her potential resources are great and, with inhibitions removed, she will, as all strong new countries do, make rapid strides in growth.

THE RAILWAY LABOR BILL

THE proposal now before Congress for the settlement of railroad industrial disputes was presented by joint agreement between railroad representatives and the representatives of the railroad labor unions.

This bill, the Watson-Parker bill, S. 2306 and HR 7180 provides for prompt disposition of disputes between carriers and their employes but does not seem to properly protect the public which in the end must pay the bills.

Undoubtedly the railroad managements and all other employers of labor are and always will be ready to grant the demands of their employes providing they find it possible to pass the expenses on to their customers.

By the repeal of the provisions of the law creating the Railroad Labor Board and the repeal of the provisions of the Newlands Arbitration Act the public rights are to be sacrificed.

The continuous operation of the railroads is a matter of vast importance to the public. It is, therefore, important that the railroad disputes shall not interfere with transportation but it is also important that transportation shall be available at a price which business is able to pay.

The control of freight rates by the Interstate Commerce Commission is limited by the requirement that no rate shall be fixed which does not fully compensate the transportation company for the service rendered.

A distinct limitation gives to the railroads a profit of 5½ percent upon their service. Below this return the Interstate Commerce Commission has no right to fix rates. If by mutual agreement between the railroads and their employes the cost of transportation is increased, this cost must in the end be paid by the shipper.

At the present time the railway wages are 115 percent higher than in 1913 while living costs are approximately 73 percent higher. The average annual earnings of railway workers in 1913 was $1,115. In 1925 this has risen to $2,348.

The public is vitally concerned in the continuous and adequate transportation service but is further interested in a transportation rate which will permit the movement of its goods. The Mining Congress Journal approves the outstanding purpose of the Watson-Parker bill but we submit that in the enactment of any measure looking to industrial peace in transportation matters the right of the public to protect itself should not be abandoned.

HEAP LEACHING

HEAP LEACHING is rapidly becoming an important method for recovering low-grade minerals. While the experiments with the process have been confined principally to the copper industry, its future is now so assured that it is stated upon high authority that it will soon be extended to all base metals. Lead is already added to the list with satisfactory results. In this issue the Practical Operating Men's Department carries a splendid discussion of this process and the results that have been obtained.

ANSWERING CRITICISMS OF DISCOVERY DEPLETION PROVISION*

Attacks Upon The Discovery Depletion Provision Of The Revenue Law Are Answered—The Discovery Clause, Patent And Trade-Mark Laws Are Practical And Justifiable Forms Of Recompense

By PAUL ARMITAGE†

TAXATION is peculiarly a field cursed by nonexpert opinions. An example of this is some of the ill-considered criticisms that have been leveled against the depletion provisions of the Revenue Laws. Most of them arise from a misconception of the nature and purpose of the depletion allowance. They emanate mainly from those who have no sound knowledge of or experience in the wasting industries.

There have recently appeared in public print and elsewhere statements that the discovery depletion provision is "bad in principle and illogical in theory" is "absurd" and is creating "a preference for that group of taxpayers analogous to a debilitating and harmful luxury." Exemptions "not enjoyed by other taxpayers." These, of course, are mere arraignments; exclamations devoid of force. They present no argument. They are what John Stuart Mill well describes as "question-begging epithets" (Mill's Logic). They are no more than the assertor's statement that he does not believe in the soundness of depletion and leave the discussion exactly where it started before the statement.

THE INVENTOR ARGUMENT

This argument has been oft-repeated. A fair example of this contention is the following:

"Inventors or others who spend their time, money, and effort in the way of discoveries, do not receive any discovery depletion upon any earnings they make in the future, and I see no reason for making such an exception in the case of miners or in the interests of those developing natural resources."

The sophistry of this contention is easily exposed. Both in its facts and in its inference it is unsound.

The implication is that "inventors or others who spend their time, money, and effort in the way of discoveries," because they are allowed no discovery depletion therefore receive no bonus consideration or financial reward from the Government. The facts are otherwise. Inventors receive in the form of monopoly patents and copyrights, a reward and consequent profits far in excess of those derived by any mine discoverer from the depletion allowance.

We indorse to the limit the principle of rewarding the discoverer whether he be the inventor of some great new method, formula, or machine, the creator of a new or original work of art, of literature, or of design, the originator of a process that extends and enlarges man's knowledge and power over the forces of nature. This principle has found expression in our laws, customs, and practices for centuries.

What is a practical form of recompense in one article or science or line of endeavor is not practical in another. The discoverer of the North Pole is made an admiral with a lifetime pension. To Morse for his great inventions of telegraphy, to Bell for telephony, a patent monopoly is given and to a Mark Twain, Lowell or Emerson a copyright with its right of exclusive reproduction. To him who discovers or uncovers a great ore body or natural deposit of valuable mineral, what is given? * * * Nothing has been given save his title to the deposit, which he owned all along.

PATENT AND TRADE-MARK LAWS

The patent, copyright, and trade-mark laws granting to the inventor and author monopolies, extended in recent times by international treaty and convention to foreign countries, are some of the legal embodiments of this principle of rewarding the discoverer. The elaborate and expensive machinery of the Patent Office is maintained solely to further this policy.

Yet on analysis all inventors have done is to enlarge man's command over the forces of nature. By a parity of reasoning, the discoverer of a new and valuable ore body, deposit of precious mineral, or gas or oil well, who thereby has augmented the world's supply is entitled to a similar reward. It is not necessary that such reward should be of like form in each case. It must be fitted to the nature of the discovery. What is a practical form of recompense in one art or science or line of endeavor is not practical in another. The discoverer of the North Pole is made an admiral with a life pension. To Morse for his great inventions in telegraphy, to Bell for telephony, a patent monopoly is given; to a Mark Twain, Lowell, or Emerson, a copyright with its right of exclusive reproduction. To him who discovers and uncovers a great ore body or natural deposit of valuable mineral, what is given?

OWNERSHIP QUESTION DISCUSSED

It may be argued the discoverer of a mine or oil well is given the exclusive ownership of the deposit, that this natural resource in truth existed all along, that its title lay in the state, which, by way of reward, granted it to the finder. Therefore, it is said, the mine discoverer in the title to the deposit receives a bonus for his toil and a reward for his success commensurate with the patent monopoly given to the inventor or the copyright to the author. To give, therefore, to the prospector or wild-catter an abatement of taxation by way of discovery depletion is, it is asserted, to give him two bonuses while but one to the inventor or author. Plausible as this argument appears, it will not stand critical analysis. First, its major premise is untrue. The discoverer of a mine or oil well is not vested with the exclusive title to the deposit. Take the wild-catter, for instance. He drills into a pool—does he thereby become vested with title to that pool? Not so, all he has is the right to recover oil from his own land, title to which he has acquired by purchase or location, just the same as any farmer. But this right of recovery is subject to similar rights of all adjacent owners. Oil, under the law, is migratory, and like wild animals, belongs to him who captures it on his premises. All that is given to the oil discoverer is the part of the pool he is able to extract and recover. The necessity of recovering what oil he can promptly is imperative, otherwise his neighbors will draw off the reserves under his land. Is this, we ask, exclusive title to the discovery? Is it anything more than a mere right to extract oil in conjunction with every other well or other operator on the same pool?

THE APEX LAW

Again, the situation is no better in the discovery of mines. Here the Apex Law comes across the horizon and the

*Extracts from Part IV of Brief of the American Mining Congress on Discovery Depletion filed with the Finance Committee of the United States Senate.

†Chairman, General Tax Committee, American Mining Congress.

discoverer is liable to have all his treasured deposit taken from him by the adjoining owner in whose claims is found the apex, a person who has not contributed an act or a dollar toward the discovery. Is this, again, we ask, exclusive title?

Second, the minor premise is likewise unsound. Nothing is given to the discoverer of a mine or oil well which he did not own already. It is a fundamental principle of the common law, which is the law of the land, that to the title owner belongs not only the surface rights but everything under them. The principle finds expression in the ancient Latin phrase or maxim of the law: "Cujus est solum, ejus est usque ad Coelum et ad inferos." "The surface of the ground is a guide, but not the full measure, for within reasonable limitations land includes not only the surface but also the space above and the part beneath. (Co. Litt. 4a; 2 Blackstone's Comm. 18; 3 Kent's Com., 14th ed., Sec. 401)." Lindley on Mines, Chap. 1, p. 2:

> "Property in mines under the common law.—As a general rule, under the common law, minerals were the property of the owner of the land, the property in the surface carrying with it the ownership of everything beneath and above it."
>
> See *Reeves* on Real property, page 75.

This right belongs to any owner of the soil, be he householder, squatter, purchaser, or locator of a mining claim. These doctrines are inherent in our law of private ownerships. Unless we are to "progress" or "revert" to Bolshevism or Communism, we can not deny to the lawful owner of the land his title to the discovery of any ore deposit he may make thereon. Under the Constitution, we can not take it from him by eminent domain or otherwise without compensation. By every right of private property and law the discoverer of a mine who has acquired title to the patent by purchase or by legal location, is entitled to the ownership of his find therein.

Title to Public Funds

Does anybody seriously contend that the Government or the state, without recompense, might enter farm lands and explore therein for oil or minerals and seize any discovery made.

It is no answer to say that in many instances the owner has located his claim on Government or state lands. This is true of most unsettled or sparsely settled communities. To any settler, be he farmer, squatter, or miner, the state gives equal location title to the land and all its contents, provided he complies with the necessary conditions. It is not given as a bonus to the discoverer of a mine or oil well, but as an inducement to settlement and prospecting, and the use of what would otherwise be barren and waste state land, the title fee, irrespective of whether a mine is or is not discovered. When the land has become thus settled by location or purchase, such rights of relocation do not exist. In other words, the wild-catter or mine prospector is given no right to enter another's land and prospect therein. And if he did and discovered a mine the title to that mine is not given to him but belongs to the true owner of the land. The state or Government makes no gift. It requires certain sacrifices or payments from the prospector or settler. Like an individual, the state requires certain recompense that the Government feels is sufficient consideration for the title or rights granted.

Fallacious Premises

And so we say that it is on a false premise of community or state ownership in natural undiscovered deposits that this entire argument rests.

But not only are these premises false, but it is also untrue that the ownership of the natural deposit so discovered is analogous to or comparable with the patent monopoly given to the patentee.

An inventor or writer had no such monopoly under the common law. Whereas under the same law the discoverer of a mine had title to his discovery. So long as an inventor or writer kept his invention or writing secret—that is, so long as he did not publish it to the world—the courts would protect him from surreptitious theft. But once published, the exclusive right to the invention or authorship was gone.

It thus therefore appears that the inventor or writer had been given a distinct statutory monopoly as a reward, whereas to the discoverer of a mine nothing has been given save his title to the deposit, which he owned all along.

It thus appears that the so-called "inventors'" argument against discovery depletion does not stand analysis.

Deduction of Net Losses

It is argued that "Losses intended to be recouped by discovery exemption also deducted as expense" by the "large operators" or corporations and as the very purpose and reason for discovery depletion was to take care of these losses spent in years of prospecting, to allow them again as an expense against gross income is a double allowance for the same thing.

The cost of unsuccessful prospecting, it is said, is charged, first, as a loss, and then, again, recouped as discovery depletion.

First, if this argument has any truth (which we doubt), it has no application to discovery depletion in the mining industry. Discoveries in mines are made either by individual prospectors, or by a group of prospectors or mining men associated as partners or in corporate form to *prospect and develop one particular property or group of claims.* If unsuccessful, the large losses incurred generally are gone forever, and under the tax laws can not be charged against the profits of any successful development made in later years by the same group or individuals.

Again, the discovery of an ore body and the realization of substantial profits therefrom are separated by some years. The building of huge plants, the necessity of equipment, the sinking of shafts, etc., require long periods of time before actual operations commence.

Expenditures Capitalized

But the uncovering of a substantial body of commercial ore is the start of a major mining operation. Exploration and consequent losses in other fields or on other claims, if any such be in hand by that individual or group (which is unusual) cease. Consequently there seldom, if ever, are losses in exploration that coincide with the gains and are deductible therefrom. Unless allowed through discovery depletion, they are never deductible.

Further, any expenditures for major development on the property can not be charged to current profits but must be capitalized. (Reg. 65, Art. 224.) This is the reverse of the oil regulation which gives an option to charge losses in unproductive wells to current profits. (Art. 223 of Reg. 45 and 62. Art. 225 of Reg. 65.)

This furnishes a complete answer to the criticism. The deduction of exploration expense is not allowed by the regulations to mines.

Finally no consideration has been given in this criticism to the 50 percent limitation on discovery contained in the 1924 Revenue Act—which materially curtailed the allowance and levied taxes on at least one-half the operating profits for all discoveries.

Overlapping Discoveries

The claim is made that double "discoveries are allowed on one and the same deposit, not only to the actual discoverer but to adjacent owners who have had no hand in the discovery."

Whether the regulations permit "the blanketing of known pools of oil with discovery values" and whether or not this is justified or sound, we need not discuss in this memorandum. Suffice to say no such condition exists in the administration of the discovery depletion as applied to mines.

But one discovery is allowed for a valuable deposit or mine uncovered by the taxpayer. This is granted because of the taxpayer's discovery and ownership of the mine.

If the ore body discovered extends into neighboring property, discovery is allowed on these extensions only because it belongs to the original discoverer under the Apex Law. If this law does not apply, discovery is limited strictly to the original ownership. Adjacent owners are denied any discovery depletion. (See Reg. 65, Art. 220, Par. (g).)

If the law and regulations are properly administered, there can not exist a multiple discovery allowance on one and the same mine. We know of no such case.

Nor is there allowed a discovery to one who has only developed but not discovered the deposit. To do otherwise is not within the law.

A False Assumption

Aside from all this, the entire charge of multiple discoveries in oil proceeds on a false assumption, i. e., that a producing well proves 160 acres of which it is the center.

While this rule is found in the Regulations, it is not in the law and finds no support in the history, statistics, or geology of oil and gas.

A producing well proves only that one well. The extent, size, and location of the pool is still unknown and unproved. Whether it be limited to the property of the discovered well or extends beyond, and whether that extension is north, east, west, or south, or in all directions, or two or more, is wholly conjecture.

Therefore the adjacent owner who drills a new well that is successful, it has been urged with great force, is as much a "discoverer" as the wild-catter bringing in the first well.

The adjacent owner takes every risk of his well being dry and unproductive or not a commercial producer. There are numerous cases where this has occurred. Only when the entire pool has been developed and proved by drilling of wells over its area is the discovery complete. But the discovery then is not due to any one of these operators but to the entire group. They are all equal discoverers of the "pool."

Having laid down a premise that is unsound, it is simple to prove that there exists multiple discoveries in oil. If the premise is challenged, the charge fails.

The Wildcatter or Prospector

The contention is made that discovery depletion was granted for the benefit of the "wildcatter" or "prospector," but that "now practically all discovery depletion is allowed to corporations." The inference is sought to be drawn that this is abuse or misuse of discovery depletion.

It is no doubt true that one of the motives inducing Congress to grant discovery depletion was to stimulate prospecting and discovery of mines, oil and gas wells. But discovery depletion was not limited to any particular class. There is nothing in the law from which the inference can be drawn that it was solely given to individuals. On the contrary, section 234 a (9) of the 1918 and 1921 acts expressly grants it to corporations. (See also identical provision contained in section 234 a (8) in the 1924 act.) Similar provisions applicable to corporations are contained in the pending bill. These provisions in unmistakable language grant depletion to taxpayers who in corporate form make the discovery. They negative any claim that Congress intended to limit discovery to individuals.

No change or abolition of the depletion provision at this date would avoid the necessity of valuation. All the mines of the country must be valued as of March 1, 1913, for depletion under the preceding laws. This valuation in the main is already completed, and once finished furnishes a definite and fixed measure of future depletion.

The purpose of the discovery provision was to reward the discoverer and to stimulate the continuance of discovery of large natural deposits needed by the country. It was immaterial to this purpose whether the discovery was made by an individual wildcatter or prospector, or by a group of prospectors operating in partnership association, or in corporate form. There is nothing *malum in se* about carrying on business operations in the corporation form. It certainly would have been a gross discrimination by Congress to have allowed the discovery to individuals but denied it to the same individuals, associated in a corporation. The size of the corporation is quite immaterial. Whether it be small or large it is equally entitled to the allowance if it has made a real and true discovery.

Corporate Wildcatting

When analyzed, therefore, the charge amounts to no more than that most discoveries are now made by prospectors and wildcatters associated together in corporate form. If true there exists a ready explanation.

As pointed out by Senator Smoot in an article in the Mining Congress Journal, December, 1925, the mining industry "is no longer pick and shovel which can be exemplified by a prospector and a burro. It is in itself a huge manufacturing operation." (See Senator Smoot's article, Mining Congress Journal, December, 1925.)

Discoveries are not made near the surface, but only after a large amount of money has been expended, development work, and equipment installed. The average cost of an oil well is in the neighborhood of $30,000 and in some cases runs as high as $150,000. Many of them are sunk to a depth of 5,000 feet before oil is encountered.

Mines are located and discovered now at unheard of depths. The Michigan companies are now operating at a depth around 3,000 to 4,000 feet. The last discoveries of copper in Arizona of a large copper mine was at a depth of 1,200 to 1,700 feet below the surface. Prospecting operations of this character require a risk and expenditure of huge sums of money over a long period of time in extensive explorative operations. Such discoveries can not be accomplished by an individual prospector with a pick and shovel.

As this requires the cooperative effort and risk of many individuals, it naturally takes a corporate form with the result that the ultimate discovery is made by the corporation. *The stockholders of these enterprises are the true "wildcatters" and "prospectors" of the mining industry in its modern form.*

No sound reason, therefore, exists for denying discovery depletion to them.

"Discovery of a Mine" Means the Discovery of a Developed Body of Ore that Can Be Operated at a Profit—Otherwise the Discovery Depletion Provision Is Meaningless

The Commissioner is criticized for ruling that "a mine or 'well' means a developed mine or well which can be operated at a profit and that there is no discovery of a mine or an oil or gas well until it has been shown that it can be profitably operated."

This ruling, we contend, is in the exact accord with the law. The law does not state "the discovery of ore" or of a "mineral deposit," or "of some evidence of a mineral deposit." The taxpayer must have discovered "a mine" of *"a value materially disproportionate to cost."*

The criticism entirely ignores the wording of the law. It treats the subject as if the statute read *"the discovery of mineral deposit or ore."* The whole subject is viewed from the standpoint of a prospector locating a mining claim, doing some assessment work and finding traces of ore or mineral. That may be a sufficient "discovery of ore" to sustain the location but *is in no sense "a discovery of a mine."*

Every great mining discovery is preceded by the location of a claim, by the uncovering of ore or some evidence of such. But this, if held to be a discovery, as shown, would preclude a discovery allowance. Hence, under this construction, there would be attributed to Con-

gress the intention of granting discovery depletion in the law under conditions that made allowance impossible. Congress did not intend any such absurdity and, therefore, used the phrase "discovery of a mine," which presupposes the full development of the ore body and the establishment of its commercial value.

And why, we ask, should not this be the construction of the law? If the discovery allowance is sound, why should not the discoverer be given the benefit of his full discovery at its actual value?

VALUATIONS

We need not discuss certain difficulties in valuation, much stressed if not exaggerated, because such difficulties inhere throughout the entire tax laws. Such valuations are required on the following matters: (1) Depletion on discovery; (2) depletion on March 1, 1913, value; (3) inheritance taxation; (4) capital stock tax; (5) amortization allowance; (6) depreciation allowance; (7) other property allowance, such as obsolescence; (8) gain and loss arising on sales of capital assets acquired before March 1, 1913, or by bequest, devise, inheritance or gift; (9) inventories; (10) valuation of intangibles; (11) many other subjects.

Such problems of valuation can not be escaped in a law which measures the tax by *net income*. Unless some other system radically different is to be substituted, valuation is essential to the administration of an income tax act.

No change or abolition of the depletion provision at this date would avoid the *necessity of valuation*. All the mines of the country must be valued as of March 1, 1913, for depletion under the preceding laws. This valuation in the main is already completed and, once finished, furnishes a definite and fixed measure of future depletion. Save in the zinc and lead mines the number of discoveries are relatively few.

The existing difficulties, therefore, of valuation in the administration of the depletion provisions as applied to mines have been stressed out of all proportion. They exist if at all in the past rather than in the future.

This, in the main, takes up and meets the objections to discovery depletion. They appear in various guises and different forms. But when examined critically are not sound or convincing. They result either from a misunderstanding of the law or its application to the mining industry.

ARIZONA CHAPTER OFFICERS

AT A MEETING of the Arizona Chapter of the American Mining Congress held on December 7, 1925, the following officers and directors were elected for the ensuing year: F. W. Maclennan, governor; W. S. Boyd, first vice-governor; H. A. Clark, second vice-governor; W. B. Gohring, secretary; directors—P. G. Beckett, W. S. Boyd, H. A. Clark, G. M. Colvocoresses, M. Curley, J. S. Douglas, J. P. Hodgson, Wm. Koerner, J. Kruttschnitt, F. W. Maclennan, W. G. McBride, T. O. McGrath, T. H. O'Brien, G. W. Prince, R. E. Tally and F. A. Woodward.

MINING CLAIMS

THE interior Department announces that applications for the survey of mining claims accompanied by a certified copy of the location certificate and the necessary deposit, should be made to the public survey office for the district in which the claims are located. The Office Cadastral Engineer will receipt for the deposit, issue the order for survey, if appropriate, administer all work in connection therewith, approving plat and field notes of such survey, and otherwise perform the duties prescribed by the mining regulations to be performed by the former Surveyor General, including certification as to expenditure made upon the claim.

MINERAL SURVEYS

THE Interior Department announces that applications for appointment as U. S. Mineral Surveyor should be addressed to the public survey office in the district for which appointment is desired. That office will make a thorough examination of the applicant's technical qualifications. If approved by that office the application will be forwarded to the Division Inspector for report as to the applicant's general reputation and fitness. Upon receipt of favorable report, recommendation for appointment will be made to the Supervisor of Surveys, who will issue the appointment through the public survey office, the applicant filing the customary bond, which will be forwarded to the Supervisor of Surveys for approval, together with the report of the Division Inspector. These papers will be sent to the general land office for acceptance of the bond. Notice of acceptance will be mailed to the public survey office and the Supervisor of Surveys, and the surveyor advised by the public survey office.

REORGANIZATION ALASKA RAILROAD

REORGANIZATION of the activities and working forces of the Alaska Railroad and the Bureau of Education at Seattle, Wash., into a consolidated office has been announced by Secretary Work of the Interior Department.

A saving of approximately $16,000 annually will be effected through a reduction in payroll, rental, and elimination of duplications. Previous to the reorganization, the Alaska Railroad maintained an office at Seattle for the purchase of supplies for the road as well as a disbursing service. The Bureau of Education also operated a separate office purchasing supplies for native schools and hospitals in Alaska, including the disbursement of funds. As both the Alaska Railroad and the Bureau of Education are under the supervision of the Interior Department, it was found feasible to consolidate the two branches into a central office with increased efficiency.

MILLING CONDITIONS IN TRI-STATE ZINC DISTRICT

WITH the object of improving present milling practice in the Missouri-Kansas-Oklahoma zinc district, the Bureau of Mines, Department of Commerce, is continuing, at its Mississippi Valley station, Rolla, Mo., the investigation of milling conditions in that district. Milling practices in vogue in this district are gravity concentration by jigs and tables, and flotation. Efforts have been directed to a study of fundamental milling principles and of improvements in the operation of the concentrating devices already in use. The two main sources of blende loss in the Tri-State mills are in the "chats" and the slime. The investigation of these losses has consisted of two phases: the isolation of the chats and of the slime, and the treatment of each after its isolation. Progress has been made in isolating the chat and in its subsequent treatment. Thorough desliming and flotation are solving the slime problem. Some of the ideas resulting from these studies have been put into practice in a number of mills. Lower grade tailings and reducing milling costs have resulted. The average mill tailing from a Tri-State ore should not contain over 2 percent blende, whereas the average in the past has been nearly 3.5 percent. On the basis of the total production of the district, the loss of 1 percent blende is equivalent to a loss of $5,000,000 annually. Since the beginning of this investigation, flotation, with filtering or drying of the concentrate, has been urged. Within the past year flotation has made a tremendous advance, and there are now fifty mills in the district employing flotation. Differential flotation of galena and blende has been definitely established, and has promoted the introduction of filters; there are now about twenty-five filters in the district. Much interest in better milling has been aroused, and there seems to be an earnest effort on the part of the operators in the district as a whole to recover more mineral per ton of rock mined.

WHAT IS A FAIR WAGE FOR A MINER

Pay Should Depend Upon Ability To Produce—No Formula Yet Devised That Accurately Operates In Apportioning Wealth To Those Concerned: Fair Treatment And Happy Surroundings Preferable to Higher Pay In Organizations Where These Do Not Exist

By SIDNEY J. JENNINGS *

THE Division of Industrial Cooperation of the American Mining Congress is promoting, through all the means available to it, a sane and just relationship between employer and employe in the Mining Industry.

The leaders of the Mining Industry realize, in the words of Mr. Andrew Carnegie, that an organization of contented and willing workers is the best asset of any corporation. They are constantly striving to achieve this goal, that they sometimes fail is due to the inherent difficulties, not to the lack of the will to try.

Mine workers as a class are independent and consequently determine their own course of action. Their work is performed under different conditions from the vast bulk of the labor of the world; underground, in an even temperature, with less than the usual amount of supervision, its appeal therefore is to men of adventurous disposition, of judgment sufficient to protect themselves from the most usual danger of the fall of ground, of enough initiative to make them able to do work without the constant supervision of a boss. This natural selective process results in the gathering together of an organization fully conscious of its own rights and adequately equipped to maintain them. This picture of the normal type of man engaged in mining is far removed from the conventional one as painted by novelists and feature writers of the newspapers, but it is a picture painted from observations made over many years and in many countries.

When a careful enquiry is made into what workingmen want, two fundamental requirements are found. The first is—a job; and the second is—a better job. The improvement in the job consists in the first place of more favorable conditions under which work is carried on; and in the second place, and I put it advisedly in the second place, better pay. My experience is that a miner will prefer to continue working in a mine where the conditions of work are agreeable to him, and where his treatment by the bosses is fair and uniformly just; to working in a mine where the pay is materially more but the conditions do not suit him, and where he is unable to predict what sort of treatment a capricious boss may give him.

It is open to all employers to see that the foremen they engage are fair minded and well spoken men and that the employe has a chance to appeal to a higher official from what he considers an unjust treatment by a foreman. The employer can also see that the conditions under which the men work are as favorable as circumstances will allow. After

Sidney J. Jennings

having done all this what is the yard stick on which the employer and employe can mutually agree, to measure the monetary reward as compensation for the work done, or what is a fair wage?

The base rate of a fair money wage should be sufficient to allow a man to feed, to clothe, and house himself, and to have enough leisure to recuperate his strength and increase his ability to earn. In each classification of workers there should be a variation in the rates of pay dependent upon the ability to produce results; so that a man who desired to marry and bring up a family could do so by increasing his efficiency and consequent monetary reward.

The answer to the question of what is a fair wage cannot be a simple statement of an arithmetical nature. An inspection of the payrolls of any industry shows the great fluctuations in the hourly rate paid by different companies for work rated under the same classification. Of course a still wider variation occurs in any one company due to changing values placed upon the work done by the various classification of workers.

No formula has been devised that will operate with mathematical accuracy in apportioning the wealth produced by the joint efforts of capital, labor, management, and the effective demand of consumers among the four classes contributary to that wealth. If the effective demand of consumers is increased by lowering the price of a commodity the total amount of wealth created may be greatly increased and the share to be apportioned among the first three classes will in the same measure be increased. The tendency of unenlightened selfish interests represented in each of these classes is to claim for their class the entire increase in wealth made by their joint efforts. This claim naturally produces friction and strife. The representatives of capital and management being small in number can generally hammer out their differences and arrive at a conclusion that is mutually satisfactory, and that endures for a reasonable period of time. If, however, management join forces with labor and hires capital, the outcome may be successful in producing wealth; but it almost inevitably, and generally in a short time, turns the individuals composing the management into capitalists who with increasing power lose their touch with labor. In either case the strife soon resolves itself into a struggle between capital and labor over the division of the wealth produced.

The method of adjusting this strife that gives the greater promise of peace is by a bargain between the two parties. Let each company and the men it desires to employ agree on a fair rate of wages. Enlightened self interest has shown capital that high wages coupled with high efficiency produces most profits for both parties. The increase of the non-union mines has proven that the principal of a bargain between an individual company and its employes is the one most conducive to a peaceful adjustment of all causes of friction according to all the circumstances of the case.

It is the manifest interest of society to see that no (*Continued on page* 144)

*Vice-President, United States Smelting, Refining and Mining Co.

NEW METALLURGICAL LABORATORIES OPENED

Bureau Of Mines Opens New Laboratories—Cooperation Of Carnegie Tech And Local Agencies Pledged

THE new metallurgical laboratories of the Pittsburgh Experiment Station of the Bureau of Mines were formally opened on the evening of January 26. The new metallurgical laboratories are the outgrowth of an agreement made in 1923 under which Carnegie Institute of Technology appointed an advisory board for its Department of Metallurgy and arranged for cooperative research fellowships in metallurgy at the Pittsburgh Experiment Station of the Bureau of Mines. Under the arrangement, certain problems in the metallurgy of iron and steel formerly conducted at the Northwest Experiment Station of the Bureau of Mines, Seattle, Wash., are being studied at Pittsburgh. In the study of these problems, the well equipped laboratories of Carnegie Institute of Technology will be available to supplement those of the Bureau of Mines.

Among the technical problems that are being studied by the newly established metallurgical section are the melting of sponge iron; reduction and carburization in iron smelting; mill ball compositions and preparations; abnormality in case carburized steels; nonmetallic inclusions of steel; and requirements for open-hearth refractories.

The equipment includes a modern electric-furnace laboratory; a metallographic laboratory, and a chemical laboratory. The metallurgical section of the Pittsburgh Experiment Station is under the general supervision of D. A. Lyon, assistant director and chief metallurgist of the Bureau of Mines, and S. P. Kinney, the supervising ferrous metallurgist.

The work of the metallurgical section is aided and supplemented by fellowships supported by Carnegie Institute of Technology and by local industries. The four fellows working on metallurgical problems this year are Ralph B. Norton, a graduate of Massachusetts Institute of Technology, in electrochemistry; Gustave H. Pfeiffer, a graduate of Rose Polytechnic Institute, in chemical engineering; Abraham Grodner, a graduate of Carnegie Institute of Technology, in mechanical engineering; and E. A. Hertzell, a graduate of Pennsylvania State College, in chemical engineering.

The problems to be studied by the four research fellows are temperature and heat flow in open hearths; case carburized steel, and open-hearth refractories.

The work at the Birmingham station deals with the beneficiation of low-grade iron ores, while that at Minneapolis has to do with reduction processes and also the utilization of some low-grade ores. At Minneapolis, the fundamental principles of ore reduction are being studied with an experimental blast furnace, and the possibilities of direct processes for making steel are being investigated.

The Pittsburgh section will handle all electrometallurgical problems of the Metallurgical Division of the Bureau except some relating to the electrothermic and the electrolytic treatment of zinc ores which are being studied at Rolla, Mo., and at Salt Lake City, Utah, respectively. To Pittsburgh, also will be consigned all those problems that involve the physico-chemical reactions of steel and iron making. Work on these problems will include studies of the general reaction between metal, slag, and atmosphere, oxidation and de-oxidation, de-sulphurization, de-phosphorization, the effect of alloying materials, and studies of refractories under service conditions.

The Metallurgical Advisory Board which will assist in the work of the new laboratories is composed of the following named:

T. D. Lynch, research engineer, Westinghouse Electric Co., East Pittsburgh, (Chairman); F. N. Speller, chief metallurgical engineer, National Tube Co., Pittsburgh; Dr. James Aston, director of research, A. M. Byers Co., Pittsburgh; F. B. Bell, president, Edgewater Steel Co., Oakmont; Earl Blough, technical director, Aluminum Co. of America, Pittsburgh; V. B. Brown, general superintendent, Allegheny Steel Co., Pittsburgh; Roy H. Davis, manager, Park Works, Crucible Steel Co. of America, Pittsburgh; A. N. Diehl, vice-president, Carnegie Steel Co., Carnegie Bldg., Pittsburgh; George H. Faunce, president, Pennsylvania Smelting Co., Pittsburgh; A. C. Fieldner, chief chemist, Bureau of Mines, and superintendent of Pittsburgh Experiment Station; James Graves, vice-president, Duquesne Light Co., Pittsburgh; S. A. Grayson, president, Jessop Steel Co., Washington, Pa.; J. O. Handy, director of special investigations, Pittsburgh Testing Laboratory, Pittsburgh; O. H. J. Hartsuff, general superintendent, Edgar Thomson Steel Works, Braddock; C. W. Heppenstall, president, Heppenstall Forge & Knife Co., Pittsburgh; F. B. Hufnagel, president, Pittsburgh Crucible Steel Co., Pittsburgh; Archibald Jones, metallurgist, American Steel & Wire Co., Pittsburgh; D. A. Lyon, acting director and chief metallurgist, Bureau of Mines, Washington, D. C.; W. E. Moore, president, Pittsburgh Electric Furnace Corp., Pittsburgh; George H. Neilson, vice-president, Braeburn Steel Co., Braeburn; C. F. W. Rys, chief metallurgical enginner, Carnegie Steel Co., Pittsburgh; S. G. Stafford, Vulcan Crucible Steel Co., Aliquippa; R. E. Zimmerman, assistant to vice-president, American Sheet & Tin Plate Co., Pittsburgh; Edward Steidle, Carnegie Institute of Technology, Pittsburgh, (Secretary).

PROGRESS OF DIFFERENTIAL FLOTATION PROCESS

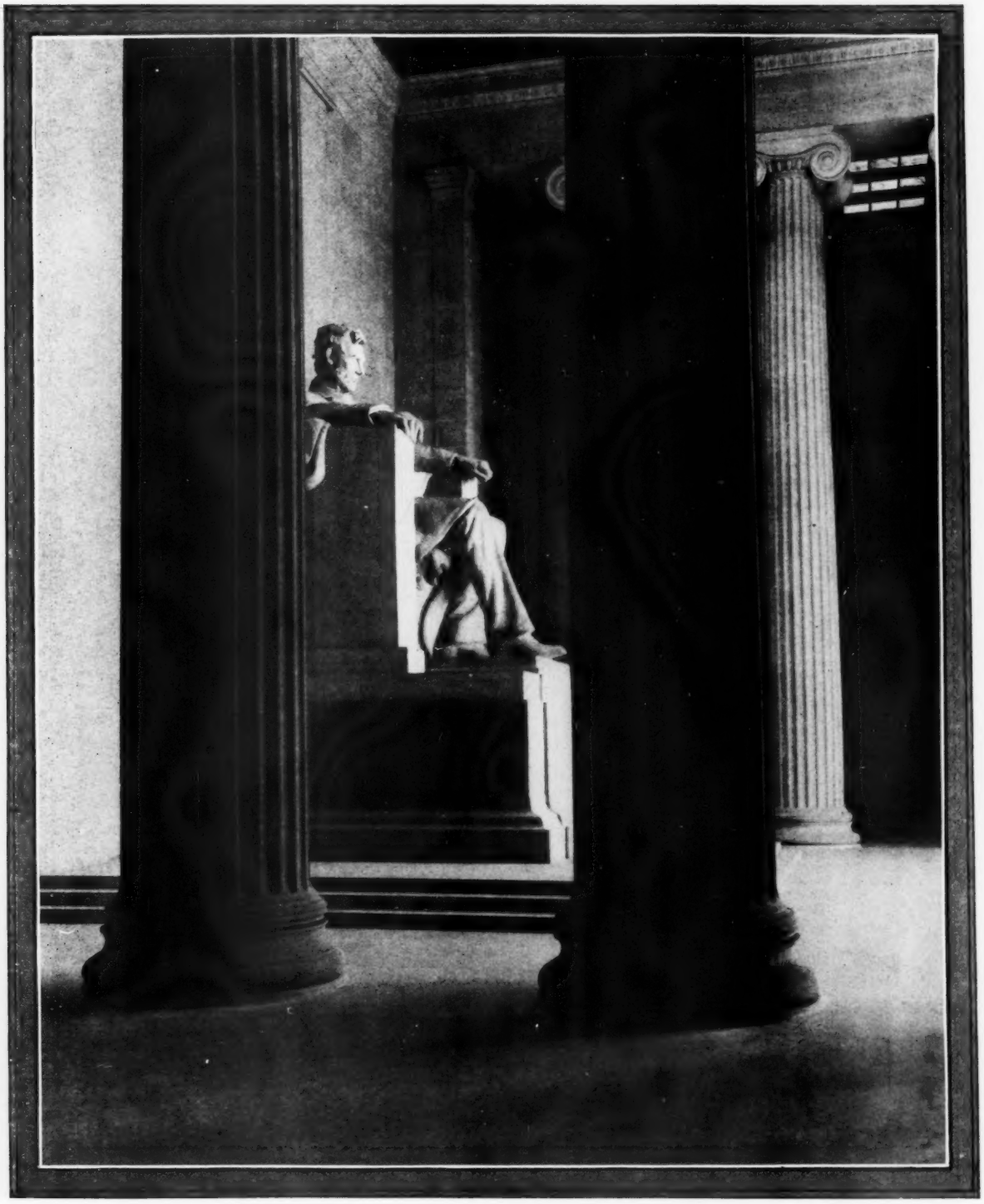
THE rate of progress in the past three years in the development of the differential flotation processes for the treatment of complex lead-zinc, lead-zinc-iron, and copper-iron ores has been rapid beyond the realization of most people, according to the Bureau of Mines. Differential flotation is no longer a "delicate" and unreliable process but is now in wide use, states A. W. Fahrenwald, ore dressing engineer, in Serial 2700, recently published. Its "safety" is due to the wide use of chemicals which either depress or enhance floatability by definite modification of surfaces.

The extent of the development and reliability of differential flotation methods may be emphasized by pointing out that there are now several custom "all-flotation" plants in this country treating complex lead-zinc-iron ores from widely separated mines. While these ores differ in chemical composition and apparently in physical nature, the various ores treated in such plant are passed through the same crushing and grinding equipment and through the same flotation machines and flow sheet with only slight changes, if any, in quantity and kind of chemicals and oils added.

Some of the development in differential flotation is due to intelligent research on the part of well trained chemists and metallurgists; much of it must be attributed to empirical testing.

Much of the success in differential flotation is due to more care being given to constant conditions with regard to such factors as fineness of granding, density of pulp entering flotation machines, quantity and constancy of oils and chemicals added to the pulp, and place of addition of reagents, and time of "conditioning" treatment of pulp with reagents.

Copies of Serial 2700, "Present status of differential flotation," may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.



In This Temple
As In the Hearts of the People
For Whom He Saved the Union
The Memory of Abraham Lincoln
Is Enshrined Forever

Inscription above the statue in the Lincoln Memorial

ISSUES IN THE ANTHRACITE CONTROVERSY

The Operators Have Asked The Miners To Justify The Money They Received Or Surrender It —The Miners Have Studiously Evaded The Issue

By GEORGE H. CUSHING

THE interesting development of the month was the effort of the anthracite miners and operators, by a further conference, to compose their differences and to arrive at an armistice, if not, indeed, at a treaty of peace. The conditions under which this conference was held were such that they should be made a matter of record as exposing thoroughly the position of both parties to the controversy.

The operators, throughout, have been peculiarly free of the least suggestion of passion in their dealings with the men. While this strike has been in progress, the operators and their striking miners have mingled freely around the idle mines and have talked things over as friends and neighbors. At the Christmas holiday season, the operators made up something over 40,000 baskets which they gave to the impoverished members of their working force. They even supplied toys for the younger children. Subsequently they have contributed largely to the maintenance of the soup kitchens and other measures of relief extended by the chambers of commerce. In dealing with the officials of the Miners' Union, they have been courteous and in making their statements to the public, there has been no acrimony, but only an even-tempered firmness on the plain business proposition.

Their business proposition was that already the price of anthracite is so high the people are in rebellion and turning to substitute fuels. They can't name any higher price without losing more trade for themselves and more work for their men. They have said that strikes are costly to themselves and to the men. They call attention to the fact that these men have been on strike twelve months out of the last forty-five —more than 25 percent of the time. This idleness is a great loss to the operators; a larger loss to the miners; and, that kind of annoyance to the public which is driving trade into other channels. They want strikes eliminated and they want to put a period to the steadily rising cost of producing anthracite.

Because they had no bitterness, but only a plain business proposition to talk out, the operators were willing to enter any conference, at once, and, in truth, were unwilling to stay out of conference.

On the contrary, the representatives of the Miners' Union had summarily adjourned the first conference before the operators had an opportunity to present their case. They were disposed to stay out of the conference until the operators should call them in to say that they were willing to surrender on one of these major points. Being in that mood, the Union officials—Mr. Lewis, in other words—would not have sought a conference at all. He entered one only when driven to it by the demands of the miners themselves. It is matter of record that, under the leadership of the priests in the foreign language section of the Catholic church, the miners demanded of their natural leader, Mr. Thomas Kennedy, that the Union go into the conference which was then being proposed. The penalty was to be that the miners would abandon the International Union and seek peace on their own terms, through their own leaders. And, it was a telegram outlining this fact by Mr. Kennedy to Mr. Lewis which practically forced the latter to consent to the conference.

When the attitude of the two sides is thus made clear, we are in better position to understand the issues which were presented by both sides. The attitude of the operators is rather exactly expressed by an incident. Starting something like four or five years ago, on the Pacific Coast, the open-shop movement has been spreading throughout the nation with remarkable rapidity. As it spreads, it gains adherents and hence, momentum. Every new convert becomes an apostle who is seeking other converts. And, when an issue of this kind arises, the natural tendency is for these converts to attempt to proselyte among the anthracite operators. In this case, it was pointed out to the operators that it may have been true, five months ago, that the operators could have renewed the expired scale without any damage to themselves, because the people had, then, not formed the habit of using substitutes. This strike, however, has taught a host of anthracite users to use something else. To that extent, the anthracite industry has been damaged. It was, therefore, a very plausible suggestion that the operators make public announcement of this damage and that they demand an actual reduction of the scale. The firm reply of the operators was:

"We have promised the miners a renewal of the expired scale. We have made that promise public. We are going to keep faith with the miners and the public."

That forms the background for the suggestion of arbitration which the operators made to the miners. They didn't propose, and from the foregoing statement, never have proposed, that there should be submitted to a board of arbitration the broad question: "What, under all the circumstances, should these men be paid for their work?" There was not involved a question, if you please, of the living standards of the men. That question, in that broad form, was never to be submitted to arbitration. On the contrary, arbitration was confined to narrower limits. It had its definitely understood minimum and maximum terms. No award of arbitration should be allowed to touch the living standards of the men; certainly, no award of arbitration should be allowed to touch the solvency of the companies. About the only question that was to be submitted to arbitration was the following simple matter, now familiar to every thinking man in the country. Without going into the subject with such metriculous care as to express it in mills and fractions of mills, the value of a dollar today, is somewhere around 70 cents. It has been fluctuating back and forth for the last six or eight years.

What the operators were saying, in truth, was that if you concede a 70-cent dollar, the present standard of living of the anthracite miners requires the expired scale. But, if the dollar should, within the life of the contract, drop to 65 cents or 60 cents, and if the miners should say that they needed more of those cheap dollars to maintain their standard of living, the operators conceded that to be a point for arbitration. However, if the value of a dollar should rise to 75 cents or 80 cents or, even, to par, the standard of living would not be touched if the miners were given fewer of those more valuable dollars. The thing that was to be maintained, therefore, was the standard of living.

Also there was another major question involved. Money, when paid to labor is, supposedly, at least, paid for effort expended. Labor is effort, since the law says it is not a commodity. What the miners have to sell, therefore, is effort. The operators were saying to the men that the public is now aroused over the price of coal. Somehow that price must come down. Mr. Warriner phrased this exactly, as early as last June, when he said that, by a little greater expenditure of effort, or even a little greater intelligence behind the present effort, the labor cost of coal production could be brought

down without touching the scale or the standard of living of anything else. The operators are struggling to satisfy the consumers in order to keep business going. They want the miners to exert their effort in that direction. They are willing to pay for the effort. However, the operators are not willing to pay out money to have men avoid effort. Their only suggestion to the men was that, if they wanted the scale, they should exert themselves to the utmost to reduce the labor cost of producing anthracite, so that the consumers might be satisfied.

So far as the public statements of Mr. Lewis have gone, they have never once touched either of those points. Mr. Lewis has ignored the fact that the operators have guaranteed to maintain the present standard of living. He has ignored the fact that the questions to be submitted to arbitration were so decidedly limited as just outlined. Rather he has flashed upon the public thought the belief that living standards, even, were to be involved. And he has wholly brushed aside any idea that the men would be willing to do anything in the way of more intensified or more intelligent work to reduce the labor cost of production. What he wants is the scale, regardless of any effort on the part of the men to earn that scale.

Being found in that wholly untenable position, Mr. Lewis had to say something else to the public which would detract attention from these two major points, so cogently reasoned by the operators. Therefore Mr. Lewis has brought up in the conference, first, a suggestion that the books of the operators should be thrown open for public inspection—that the profits, as he expressed it, of the operators should be disclosed. He then suggested that the operators should agree to ask the Government to regulate the anthracite industry, and thus to insert an outside force as a governing body in the coal business.

When matters stand in that way as between the two directly interested parties, the reactions of the public groups have been most interesting and enlightening. The governor of Pennsylvania, in making a suggestion to the state legislature, which he had called into special session for the purpose of considering this matter, followed almost exactly the lines of Mr. Lewis' argument to the operators. He, too, had suggested the opening of the books of the companies; the declaration that coal is a commodity charged with a public interest; the regulation of the industry by the Public Utilities Commission; and revision of the freight rates to allow the miners to get what they want without increasing the price to the public. He went one step further, and suggested to the legislature that they propose some form of organization among the consuming states which would exercise a regulatory influence over future actions of anthracite.

The legislature, upon receipt of these suggestions, decided to postpone consideration of them indefinitely. The legislature then brought forward a suggestion of its own. It was that the miners' license law be repealed, or at least modified to the necessary extent to destroy the monopoly of the right of the present anthracite miners to work in the anthracite mines. The theory of the legislature was that the state was beyond its powers if it gave to any group a monopoly of the right to labor in any particular district, especially when that monopoly was employed to deprive people of their coal.

The same issues have, on several brief occasions, been carried into the Congress of the United States. One member of Congress made the interesting suggestion that an embargo be declared on the export trade in anthracite. This was interesting in view of the fact that no anthracite is now being produced which could be embargoed. Thus the effect of the law would be to limit the market of the operators when anthracite production is resumed. Another bill suggests that the Government seize and operate the mines for the next two years. Among other proposals were that the President should be empowered and instructed to call the anthracite operators and miners into conference for the purpose of trying to compose their differences. The latter subject was undoubtedly the most interesting, because of the debate which it developed in the Senate. Some members of the Senate arose to inquire:

"If we empower the President to do this thing; if the President shall invite these gentlemen to the White House; and, if they shall disagree in his presence, as they have done in their own conferences, what will be the next step? Anthracite production is local; it is beyond the police powers of the Federal Government. What can be done by the Federal Government to compel the production of anthracite? The right to compel production is the right to make a man work against his will. Such a right, therefore, destroys the freedom of the individual, and, if expressed in one constitutional amendment, would repeal the whole section of the Constitution which safeguards individual liberty."

These are the issues that have been involved in the anthracite strike. A disagreement over these issues has, at the moment, caused a suspension of negotiations. It is difficult to see how, until there is some radical change among the negotiators, there can be a change in the situation.

SENSITIVITY OF COALS

AN investigation to determine the sensitivity of various coals and coal constituents by the critical temperature method and also by the calorimetric method is being conducted by the Bureau of Mines in cooperation with the Mines Safety Research Board of the British Government. An effort will be made to obtain more data on the purely physical factors involved, of ventilation, heat flow, moisture, etc.; and to develop practical application of the theories of autoxidation. Work already done has shown that all bituminous coals when dry will heat to ignition from temperatures around 35° C. provided adiabatic conditions are maintained and sufficient oxygen is applied. Below 35° C. their behavior is still uncertain. If the coal contains moisture it may heat or cool, depending on its saturation relative to that of the air or oxygen supplied.

STEAMING VALUE OF COAL AND COKE

THE results of a series of tests conducted by the Bureau of Mines to obtain further information on the relative steaming values of coke and bituminous coals burned in a hand-fired low-pressure cast-iron boiler of a size suitable for heating large buildings, are given in Technical Paper 367, just issued. In conducting these tests, at the bureau's Pittsburgh experiment station, large quantities of coal were fired at rather long intervals, approximating the practice of firing that would be followed by firemen or janitors in office or apartment buildings and in schools. Another purpose of the tests was to separate the heat losses, in order to determine the effect of the method of firing and of structural changes in the boiler, when the boiler was operated at ordinary capacities.

Further details of these tests are given in Technical Paper 367, "Value of bituminous coal and coke for generating steam in a low-pressure cast-iron boiler," by C. E. Augustine, James Neil, and William M. Myler, Jr., copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

In restoring the 13-cent stamp to use, the Post Office Department says:

"Our silver quarter is written all over with 13. There are 13 leaves in one claw and 13 thunderbolts in the other claw of the eagle. On his breast is a shield bearing 13 bars and from his beak is a ribbon bearing the motto with 13 letters. Each wing has 13 feathers, and it takes 13 letters to spell quarter dollar."

METAL MINING IN THE UNITED STATES IN 1925

On The Whole Mineral Production For 1925 Shows Substantial Increase—Gold Production Alone Decreasing To Any Great Extent—Copper More Than Holds Its Own And Lead, Zinc And Silver Show Substantial Increase—Outlook For Production During 1926 Is Unusually Bright

Alaska

Slight Increase in Total Value of Mineral Output—Gold and Coal Showing Decrease—Outlook Very Bright

MINES in Alaska produced minerals to the value of $17,850,000 in 1925, as against $17,457,333 in 1924. The total value of the mineral output of Alaska since 1880 is nearly $553,000,000. The figures for 1925, which are estimates and subject to revision, are taken from the U. S. Geological Survey's annual report on the mineral resources of Alaska, now in preparation. The source of this mineral wealth is approximately as follows:

Value of Mineral Output of Alaska in 1924 and 1925

	1924	1925 (Est.)
Gold	$6,285,724	$6,150,000
Copper	9,703,721	10,350,000
Silver	448,659	475,000
Coal	559,980	375,000
Other minerals (lead, petroleum, marble, gypsum, tin, platinum, etc.)	459,249	500,000
	$17,457,333	$17,850,000

General Conditions

On the whole, the condition of the mineral industry of Alaska in 1925 showed improvement over the preceding year. It is true that there was a decrease in the production of gold and coal, but these decreases are believed to have been of only temporary significance and do not at all indicate a permanent decline. In fact, throughout the Territory there were unmistakable signs that many of the operators were putting their properties in a more efficient condition and that people with capital were seeking opportunity for investment in large operations of stability rather than in projects that would be quickly worked out or in speculative mining ventures. The influence of improved mining methods and larger-scale operations have already begun to yield results at some of the mines, and further effects are to be expected in 1926, though it may still be several years before all the projects now under way will be significantly reflected by an increase of production.

The most notable development at any of the gold lode mines during the year was the enormous amount of ore handled by the Alaska Juneau Company in the Juneau district, in southeastern Alaska, which, during some months, exceeded a rate of 10,000 tons a day. Work on the addition to this company's mill has proceeded throughout the year and is now more than two-thirds finished. Increased production was also reported by the three gold mines on Chichagof Island. In the Hyder district several of the mines or prospects made test shipments ranging from 1 to 10 tons or more the amounts of gold and silver from which have been encouraging. In Kenai Peninsula and adjacent regions some gold has been obtained from the lodes at Nuka Bay and south of Hope. The mines in the Willow Creek district have continued to be productive, and the greatest increase was made at the Fern mine, on Archangel Creek. In the Fairbanks region the Mohawk mine, on Ester Dome, and the Crites-Feldman property, on a tributary of Fairbanks Creek, yielded the greatest amount of gold, but interest in prospecting for lodes in several other places has been stimulated. A small mill was completed at the Wyoming mine, on Bedrock Creek.

In addition to the silver-lead properties in the Hyder and Kantishna districts, silver lode prospects have been reported in the vicinity of Skagway, near the international boundary, and development work has continued on the silver-lead vein east of Wrangell. Considerable silver is also recovered from the copper ores; in fact these ores still continue to be the largest source of silver produced in the Territory.

Gold Placers

There was a decided falling off in the amount of gold recovered from the Alaska placers during 1925. The only camps where marked increases were reported are the Yentna district; the Circle, Tolovana, and Koyukuk districts, in the Yukon-Tanana region; and the Fairhaven district in Seward Peninsula. According to preliminary estimates the 24 dredges in operation in Alaska in 1925 produced gold valued at about $1,470,000, or about $100,000 less than in 1924. The largest decrease in output from dredges was in the Nome district, and the principal increase was in the Yentna, Fairbanks and Circle districts. The new dredge of the Tanana Valley Gold Dredging Company on Fish Creek, in the Fairbanks district, was not completed in time to be in active operation during the year.

Copper

In 1925, as in other years, the output of copper was largely made by the Kennecott, Mother Lode, and Green Butte mines, in the Copper River region, and the Beatson mine, on Latouche Island. The total production from these properties in 1925 was slightly larger than in 1924, but most of the increase indicated in the foregoing estimate is largely attributable to the higher price of copper.

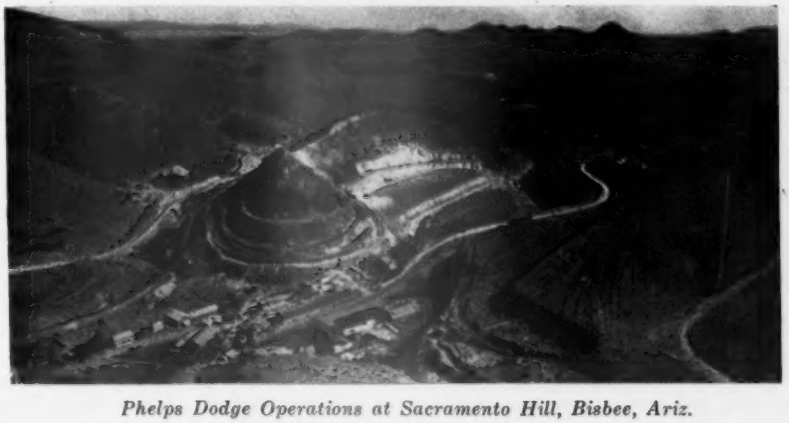
Coal

The production of coal showed a considerable decrease for the year. The outlook, however, for an increased production in 1926, if suitable markets are found, is exceedingly good.

Interest in the Bering River coal field was revived during the year, but no productive mining was in progress. Applications for coal prospecting permits were filed covering areas south of Riley Creek, near the Alaska Railroad, and a short distance north of Tanana.

Petroleum

All the petroleum produced in Alaska continued to come from the wells of the Chilkat Oil Company. This company's property is near Katalla, where in addition to the oil wells it operates a small refinery. The



Phelps Dodge Operations at Sacramento Hill, Bisbee, Ariz.

gasoline and distillate produced by the company are much in demand in the local market, as they are said to be of better grade than the usual commercial brands.

Other Minerals

Alaska, during 1925, produced lead, marble, gypsum, tin, platinum, quicksilver, and garnet. Lead showed a considerable increase in quantity and, owing to the higher price per unit, a more than proportional increase in value over the output in 1924. Most of the lead was recovered in the treatment of ores, whose principal value was their gold or silver content. The lead-bearing gold ores came almost entirely from the Alaska Juneau mine, in southeastern Alaska, and the lead-bearing silver ores came principally from the Hyder district, in southeastern Alaska, and the Kantishna district, north of Mount McKinley. The output of marble came entirely from the quarries of the Vermont Marble Co. at Tokeen, on Prince of Wales Island, southeastern Alaska. All the gypsum was produced by the Standard Gypsum Co., located at Gypsum, southwest of Juneau, on the east coast of Chichagof Island. The tin ore, or cassiterite, was derived from placers near York, in Seward Peninsula, and from the Hot Springs District, in the Yukon-Tanana region. Some of the platinum metals were won from placers in the vicinity of Dime Creek, Seward Peninsula, but the larger part was palladium, recovered from a copper lode on Kasaan Peninsula, southeastern Alaska. A little quicksilver was produced from lodes in the Kuskokwim Basin, some distance northwest of Georgetown. A prospecting party with a considerable outfit went into this same general region during 1925 to continue the examination of the quicksilver lodes. To judge from the specimens sent out, deposits of rich quicksilver ore have been found, and, according to reports, will be developed as rapidly as circumstances permit. The schists in the vicinity of Wrangell were the source of the small output of garnet that was reported from southeastern Alaska.

Arizona

With the Exception of Gold, Mineral Production Showed Decided Increase Over 1924, Copper, Silver and Lead Comparing Favorably With War Period.

THE value of the gold, silver, copper, lead, and zinc produced by mines in Arizona in 1925 was $114,327,100, an increase from $99,610,379 in 1924, according to estimates made by V. C. Heikes, of the Bureau of Mines. The output of copper, silver and lead compared favorably with that of the war period, though metal prices were lower and the output of gold, especially from Oatman, was decidedly less. Arizona retained its place as the leading copper producer of the United States and made an output close to that of 1918, despite the fact that market conditions did not warrant a record output.

The dividends paid in 1925 by mining companies in Arizona (United Verde, United Verde Extension, Calumet & Arizona, New Cornelia, Inspiration, Miami, Magma, and Arizona Commercial), amounted to $11,483,185, exclusive of $2,000,000 paid by the Phelps Dodge Corporation, which operates the Copper Queen and Morenci properties in Arizona and other mines in Mexico and New Mexico.

Much Less Gold Than in 1924

The output of gold fell off from $4,878,465 in 1924 to $4,315,200 in 1925 as a result of a large decrease in the production of gold ore from Oatman in Mohave county. The United Eastern Mining Company was closed in 1924, and the Gold Road Mine was idle in 1925, leaving the Tom Reed property the main producer of the San Francisco district. A marked change was therefore shown in the district gold output which decreased from $1,617,196 in 1924, to about $488,827 in 1925. Gold from copper ore was naturally greater, as the production of copper was unusually large.

Increase in Quantity and Value of Silver

The output of silver increased from 6,649,276 ounces in 1924 to about 7,322,600 ounces in 1925, and the value increased from $4,455,015 to $5,052,600, as the average price of silver in 1925 was about 2 cents higher than that of 1924. The United Verde mine was by far the largest producer of silver in Arizona, but other large producers were the Copper Queen, Magma, Calumet & Arizona, United Verde Extension, Shattuck, Bunker Hill, New Cornelia, Old Dominion, and Iron Cap mines.

More Copper Produced

The output of copper increased from 677,752,013 pounds in 1924, to about 725,000,000 pounds in 1925, and the value increased from $88,785,514 to $102,298,700. Eight smelting plants within the state were active throughout the year, and considerable ore was also treated at El Paso, Texas. The Old Dominion smelter was closed in December, 1924, but the mine output was handled at the International plant at Miami. Though the price of copper was not high and there was some talk of curtailment, several of the large properties such as the United Verde, Copper Queen, Ray Consolidated, Calumet & Arizona, and Morenci mines decidedly increased their output. The smelter at Humboldt was idle, but much ore and concentrate was purchased in anticipation of active operations. The largest producers of copper in 1925 were the United Verde, Copper Queen, Inspiration, Ray Consolidated, New Cornelia, Miami, Morenci, Calumet & Arizona, United Verde Extension, and Magma mines. Other mines that produced more than 1,000,000 pounds of copper each were the Arizona Commercial, Iron Cap, El Tiro, Night Hawk, Midland, Shattuck, and Superior & Boston.

More Lead Produced

The production of lead in Arizona increased from 18,642,314 pounds in 1924 to about 23,000,000 pounds in 1925, and the value increased from $1,491,385 to $2,083,800. The Copper Queen mine, at Bisbee, was the largest producer of lead in Arizona, and the Shattuck mine, which was operated throughout the year, was second. The Calumet & Arizona property was a large producer of lead from zinc-lead ore shipped east.

Much More Zinc Produced

No zinc material was shipped from Arizona in 1924, but in 1925 regular shipments of zinc-lead ore were made from the Warren (Bisbee) district to eastern zinc plants. A large output from the Calumet & Arizona mine was shipped to Kansas, and several hundred tons of mixed zinc-lead ore were shipped from a property near Globe.

California

Considerable Increase in Lead and Zinc Production, But Decrease in Production of Gold, Silver and Copper.

THE value of gold, silver, copper, lead and zinc produced in California in 1925, according to the estimate of J. M. Hill, of the Bureau of Mines, was $22,893,500, a decrease of only $44,657 as compared with the value of metals produced in 1924. There was a decrease in production of gold, silver, and copper, but considerable increases in the output of lead and zinc as compared with the previous year.

The production of gold in 1925 was $13,015,600, a decrease of $134,575 as compared with 1924, which is a very good showing considering the decrease in yield of several of the larger gold quartz mines and from copper ores. That the decrease was not larger can be attributed to the increased yield of dredges, though there were fewer boats in operation in 1925 than in 1924.

The production of silver in 1925 was 459,053 fine ounces less than the previous year, but totaled 3,096,080 ounces, valued at $2,136,295. The decrease is largely due to the fact that the California Rand Silver, Inc., was short of

mill water during the summer and was not able to produce at capacity. The decreased yield of silver from copper ores was offset by the increased yield from lead ores produced in the southern part of the state.

The production of copper in 1925 was 45,808,200 pounds, valued at $6,458,956, a decrease of 6,298,971 pounds, and of $367,083 in value, as compared with 1924. The decrease was largely the result of the closing of operations at the mines of the United States Smelting, Refining and Mining Company, at Kennett, in the late summer. The Engels and Walker mines were producing normally, and there was an increase in yield from the Bully Hill and Calaveras mines. The Mountain Copper Company resumed production of copper ores, though its smelter was not operated.

The lead mines of Southern California increased their production, as compared with 1924, by 2,247,194 pounds to a total of 7,011,000 pounds, valued at $635,196 in 1925. Most of the older well-known mines, with the exception of the Darwin, were in the producing class, and a number of newly opened properties helped swell the total.

The yield of zinc was nearly treble that of 1924, the output in 1925 being estimated at 8,651,900 pounds, valued at $652,353. Most of the zinc production was from the Bully Hill mines, in Shasta county, but zinc concentrates were also made from ores from Los Angeles and Inyo counties. By far the largest part of the zinc was carried in the form of concentrates, which were shipped abroad for reduction. Only a few tons were treated at Mississippi Valley smelters.

Colorado

Large Increase in Silver, Lead and Zinc—Gold Production Declines as Does Copper.

THE output of gold, silver, copper, lead, and zinc from Colorado ores in 1925 in terms of recovered and estimated recoverable metal was $7,205,000 in gold, 4,380,000 ounces of silver, 2,500,000 pounds of copper, 63,000,000 pounds of lead, and 61,000,000 pounds of zinc, according to Chas. W. Henderson, of the Bureau of Mines. These figures are to be compared with $8,593,116 in gold, 3,254,370 ounces of silver, 2,713,219 pounds of copper, 47,557,061 pounds of lead, and 56,727,000 pounds of zinc in 1924. The figures show an increase of 34 percent in the production of silver in 1925, 32 percent in the production of lead, and 7½ percent in the output of zinc. The production of gold declined 16 percent, and the copper production showed a loss of 8 percent. At present estimated average prices for silver, copper, lead, and zinc, the value of the output of these metals in 1925 was: Silver, $3,022,000; copper, $353,000; lead, $5,708,000, and zinc, $4,636,000. These values, together with that for gold, give a gross value of the output of $20,924,000 for 1925, as compared with $18,620,796 for 1924, an increase of about $2,303,000, or 12 percent.

There has been a notable increase in the number of men employed in Colorado metal mines in 1925. Many of the more important mines have operated 365 days of the year. Of the smaller properties, many which operated only one month in 1924, have operated full time for six to twelve months. Many old properties were reopened as the year 1925 progressed, so that December represents the maximum operations. Often in the past, the winter and early spring months have been seasons of curtailed operations. The simultaneously high prices for lead and zinc, and the search for lead and zinc ores have been the causes of the activity in development.

The tons of ore mined and marketed in 1925 and the estimated recoverable content do not reflect accurately the improvement and activity in the industry. The reopening of mines which have been idle for a year to 20 years means the expenditure of much time and labor. Some operators, such as the Leadville Deep Mines Company, of Carbonate Hill, at Leadville, started to unwater in August, 1923, but were unable to complete the removal of the accumulated water until July, 1925.

The recovered gold from Cripple Creek mines was $4,620,000 in 1925, as compared with $4,942,000 in 1924. Lack of development work during war years and imminent danger of abandonment of the district in 1920-21 are factors bearing on production that cannot be overcome in four years of slowly improving conditions in gold mining.

Lake county (Leadville and vicinity) is looking forward to greatly increased production in 1926. In 1925 the Arkansas Valley lead blast smelter started with four furnaces (of the eight on the property) treating ore from Leadville, Aspen, Creede, Ouray, Telluride, and Clear Creek-Gilpin-Boulder Counties, as well as surplus ore released by Utah smelters from Park City.

San Miguel county (Telluride and Ophir) made an increased production in 1925. The Smuggler Union mine, thought exhausted in 1912, and seemingly approaching exhaustion in 1924, continued to supply the 600-ton mill steadily. The annual report of the Tomboy Gold Mines Company, Ltd., for the year ended June 30, 1925, shows a surplus of £38,055 (approximately $184,567) after dividend payments of £26,545 (approximately $128,743).

Rico, Dolores county, where it is said only six persons spent the winter of 1924-25, reported a population of 500 people in December, 1925. This change in population was brought about by the entrance in June of the International Smelting Company with a force of 40 miners, who are opening up the old workings of the Syndicate property and in new development in the Devonian lime formation. In addition, at the Union Carbonate mine, another force of 40 men are at work, and another company, with leases and options on certain acreage in the district, has another 40 men at work. An associated company has prepared the foundations for a 250-ton selective flotation mill at Rico.

San Juan county (Silverton, Eureka, Chattanooga) likewise made an increased production in 1925. The Sunnyside selective flotation mill was operated steadily at about 750 tons a day and a materially increased quantity of lead and zinc concentrate was shipped.

Ouray county did not produce as heavily as in 1924. The Atlas mine and mill, shut down in 1924, was the scene of some work by lessees. Development work was done at the Bachelor-Khedive mine. A lease on surface workings and upper levels was granted by the

Lee, U. S. Geological Survey

Smuggler Mill, Telluride, Colo.

Camp Bird Company on the Camp Bird property, which from 1896 to 1916 produced ores with a value received at the mines of $27,296,768 and a profit at the mine, exclusive of depreciation, of $17,731,788. It is reported that at Red Mountain, 50 miners are provided with provisions and supplies and prepared to spend the winter of 1925-26 at work, as compared with two men resident there during the winter of 1924-25. Several hundred tons of silver-lead-zinc ore were shipped from Red Mountain in 1925.

The Wellington mine and mill, at Breckenridge, Summit county, shipped zinc and lead concentrate as well as lead carbonate smelting ore. The Blue River dredge below Breckenridge was destroyed by fire in June and has not been repaired. The Tonopah dredge below Breckenridge was closed down in October and is offered for sale. Development work at Montezuma resulted in shipments of lead-zinc ore to Utah and late in the year the Saints John property was taken under option. The dredge and placer mines near Breckenridge produced $84,175 in 1925, as compared with $280,361 in 1924. No great quantity of ore was shipped from Kokomo during the year, but on November 1, the American Metal Company began work with 25 men repairing and cleaning the Uthoff, Wilfley, and Kimberley adits, in preparation for exploration for lead-zinc-iron sulphide ore bodies in an area of 1,500 acres under lease. The Climax Molybdenum Company, near Kokomo, operated its mine and mill continually in 1925, milling in December at the rate of 10,000 tons per month.

Clear Creek county mines, mostly idle in 1924, experienced a renewal of operations early in 1925. The Wasatch jig and table concentration mill at Silver Plume was started in April on lead-zinc ore stored during the winter of 1923-24 in the mine buildings and in the snow sheds approach to the mill. The Watrous flotation mill, at Silver Plume, was operated one shift a day on dump ore from the Mammoth mine. The East Butte selective flotation mill at Silver Plume, operated in 1921-23 on dump material, was started in September on ores developed underground in the old Dives-Pelican-Zero mines.

In Boulder county, the Boulder county adit at Cardinal and drifts east and west on the vein cut at 800 feet depth 3,300 feet from the portal were cleaned and retimbered and milling ore began to move in July to the Boulder county table concentration and flotation mill. In October the capacity of this mill was doubled. A fire in December at the portal of the adit burned the compressor house and other buildings, resulting in the death of two of a rescue team, and closing the property for a short time. The Logan and Wood Mountain gold mines and Yellow Pine silver mine at Sugar Loaf were operated during the year. Ore from the above mentioned mines and from many small lots of ore received at the Boulder county sampler gradually increased during the summer from 50 tons a month to 150 tons a month.

Idaho

Copper, Lead and Zinc Shows Substantial Increase in Production—Gold and Silver Show Decrease.

THE value of the gold, silver, copper, lead and zinc produced from ore mined in Idaho in 1925, according to estimates by C. N. Gerry, of the Bureau of Mines, was about $31,815,750, as compared with $27,049,877 in 1924. As the price of lead increased from 8 to more than 9 cents a pound, the regular producers of silver-lead ore made every effort to market their product. Conditions were especially favorable for a large output from the Coeur d'Alene region, though one of the large mines was exhausted early in the year. The copper output was upheld by shipments from Mackay, and a good gain was shown in the production of zinc, but gold decreased decidedly from both deep and placer mines.

Mining companies reported dividends amounting to approximately $5,783,000. These were paid principally by the Bunker Hill, Hecla, and Federal mining companies.

Much Less Gold Produced

The mine output of gold was valued at $455,855, as compared with $556,523 in 1924. Dredges were operated at both Featherville and Murray, but the combined output was less than in 1924. Only a small production was made at the Gold Hill and Iowa property at Quartzburg, a large and regular producer for many years, and the output from Idaho county was much less. The largest producers of gold in 1925 were the Yukon Gold Co., at Murray; the South Park Dredging Co., at Featherville, and the Idaho Metals Co., at Mackay.

Less Silver at Less Value

The output of silver decreased from 7,793,154 ounces in 1924 to about 7,550,000 ounces in 1925, and the value from $5,221,413 to $5,209,500. Silver increased decidedly from the Morning, Hecla, Bunker Hill, Sunshine, Crescent, and Ramshorn mines, but the output from the Hercules, Tamarack & Custer, and Talache properties was much less. The Callahan Lead-Zinc Co., formerly a large producer of silver, lead and zinc was idle. In the Coeur d'Alene district, which produced about 6,600,000 ounces of silver, or 85 percent of the total for the state, the largest producers were the Morning, Bunker Hill & Sullivan, Hecla, Gold Hunter, Tamarack & Custer, Crescent, Hercules, and Sunshine mines. In other districts of the state the Talache, Ramshorn, Idaho Continental, and Independence mines supplied much silver.

Small Increase in Output of Copper

The output of copper increased from 2,738,824 pounds in 1924 to 3,016,000 pounds in 1925, and the value from $358,786 to $425,550. The Idaho Metals Co., at Mackay, operated its new flotation mill and retained its place as the leading producer of copper in Idaho.

Increase in Output and Value of Lead

The output of lead increased from 248,950,292 pounds in 1924 to 259,142,000 pounds in 1925. The value increased from $19,916,023 to $23,478,265, as the average price of lead increased to more than 9 cents a pound. The Bunker Hill & Sullivan mine at Kellogg was far in advance of any other mine in the state in the production of lead. The Morning mine, near Mullan, was second, and the Hecla, at Burke, was third. These three properties produced more than three-fourths of the lead of Idaho.

Much More Zinc Produced

The zinc recovered from ore and concentrate smelted or leached increased from 15,340,498 pounds in 1924 to 29,367,000 pounds in 1925, and the value from $997,132 to $2,246,600. Most of the output was zinc-lead concentrate shipped to the electrolytic plant near Great Falls, Mont., but some of it was milled at Anaconda, Mont., before leaching.

Montana

Gold Production Decreases, But All Other Minerals Show Increase With Exception of Zinc.

THE value of the gold, silver, copper, lead and zinc produced from mines in Montana in 1925, according to estimates made by C. N. Gerry, of the Bureau of Mines, was $60,802,000, an increase from $55,074,548 in 1924. The output of copper increased considerably in both quantity and value, and there was a slight increase in silver and lead. Gold, however, decreased about 10 percent, and zinc was much less in spite of unusually favorable market conditions.

The Anaconda Copper Mining Co. and the Butte & Superior Mining Co., according to published statements, paid dividends amounting to $9,580,392 in 1925.

Decrease in Production of Gold

The value of the output of gold decreased from $2,022,825 in 1924 to

$1,806,700 in 1925. In 1924 the Jib Mining Co. was responsible for an unusual increase in the gold output of Montana, but in 1925, though it remained an important producer, its production decreased and it was responsible for a large decrease in the state total. The Anaconda Copper Mining Co. was the largest producer of gold in the state, and the Jardine, Jib, and Drumlummon mines followed.

Increase in Silver

The mine output of silver increased slightly from 13,289,303 ounces in 1924 to 13,507,900 ounces in 1925, and the value from $8,903,833 to $9,320,450, as the average price of silver was about 69 cents an ounce. Most of the silver was produced from the property of the Anaconda Copper Mining Co., which operates copper mines and lead-zinc mines at Butte. The largest producers of silver in 1925 were the Anaconda, Butte & Superior, Silver Dyke, Elm Orlu, Anselmo, Butte Copper & Zinc, Poser, East Butte, Moulton, Block P. and Jib mines.

Large Increase in Copper Production

The output of copper increased from 249,152,062 pounds in 1924 to 269,520,400 pounds in 1925, and the value from $32,638,920 to $38,029,300. The Anaconda Copper Mining Co. was producing copper from company and custom ore at an average rate of about 22,000,000 pounds a month at the smelting plant at Anaconda. The total represents an increase of about 12 percent, but is much less than the production during the war period.

Record Output of Lead Produced

The production of lead increased from 39,476,008 pounds, valued at $3,158,081 in 1924, to 41,991,470 pounds, valued at $3,804,400 in 1925. Nearly all the lead came from zinc-lead ore mined at Butte by the Butte & Superior, Butte Copper & Zinc, Anaconda, Elm Orlu, Moulton and Poser mines.

The output of zinc recovered from ore mined in Montana decreased from 128,475,218 pounds in 1924 to about 102,500,000 pounds in 1925. The value decreased from $8,350,889 to $7,841,250. The electrolytic zinc plant near Great Falls was active throughout the year and its capacity was being increased, but receipts from Montana were less than in 1924, and much custom material was treated from Idaho, Utah, Nevada, and Washington.

U. S. Bureau of Mines

East Butte and Pittsmont Smelter, Anaconda Copper Co., Butte, Mont.

Nevada

Substantial Increase in Copper, Lead and Zinc—Gold and Silver Production Declines.

THE value of the gold, silver, copper, lead and zinc produced from ore mined in Nevada increased from $22,799,799 in 1924 to about $22,914,000 in 1925, according to a preliminary statement prepared by V. C. Heikes, of the Bureau of Mines. A substantial increase was recorded in quantity and value of copper, lead, and zinc, as the average metal prices were higher than those of 1924. The total gold and silver output, however, was considerably less, especially from Tonopah.

The dividends paid by Nevada mining companies in 1925, according to published reports, amounted to about $1,608,636. The largest contributors were the Tonopah Mining, Nevada Consolidated, Tonopah Belmont, Tonopah Extension, Yellowpine, and Betty O'Neal mines.

Transportation difficulties of the copper mines at Contact, Nev., will be solved in 1926, when train service will be started on the railroad connecting Wells, Nev., with Rogerson, Idaho.

Decrease in Output of Gold

The output of gold decreased from $4,505,686 in 1924 to $3,741,600 in 1925 on account of the marked decrease in bullion from the mines and mills in the Tonopah district. The Comstock Merger Mining Co. treated gold-silver ore at Gold Hill and remained the leading producer of gold in the state. The Nevada Consolidated mine, at Ely, was second, as a result of an increase in the smelting of copper ore, and the Elkoro gold property at Jarbidge followed closely.

More Than 2,000,000 Less Ounces of Silver

The production of silver decreased from 9,411,379 ounces in 1924 to about 7,000,000 ounces in 1925, and the value from $6,305,624 to $4,830,000. The Tonopah district produced about 3,211,000 ounces of silver, a decrease from 5,032,043 ounces in 1924, and the Tonopah Extension mine was the largest silver producer of the state, though it was followed closely by the Comstock Merger property. The mines of the Comstock district decreased their output from 1,616,692 ounces to about 1,339,300 ounces.

The output of copper increased from 73,805,323 pounds in 1924 to about 79,000,000 pounds in 1925, and the value from $9,668,497 to about $11,146,900. The Nevada Consolidated Copper Co., at Ely, increased its output and produced copper at an average rate of about 6,000,000 pounds a month. The only other important producer of copper was the Consolidated Copper mines, which shipped milling ore and first-class ore to the plants at McGill. Experimental work was also done in leaching copper ore in place.

The output of lead increased from 20,060,041

Hecla Mine and Business Section of Burke, Idaho

pounds in 1924 to about 23,700,000 pounds in 1925, and the value from $1,604,803 to about $2,147,000. The Yellow Pine Mining Co., at Good Springs, retained its position as the largest producer of lead, but it was followed closely by the Combined Metals Co., at Pioche, and the Eureka Holly mine, at Eureka.

Increase in the Output of Zinc

The zinc recovered from ore mined increased from 11,002,910 pounds in 1924 to about 13,700,000 pounds in 1925. The combined Metals Co. at Pioche was the largest producer of zinc in Nevada. Sulphide zinc-lead ore was treated at Bauer, Utah, by flotation. The resulting lead concentrates were shipped to International, Utah, and the zinc product went to Great Falls, Mont., and Florence, Colo. The Yellow Pine Mining Co., formerly the largest zinc producer, shipped carbonate ore and concentrate to eastern zinc plants.

New Mexico

Lead Production Shows Substantial Increase—All Other Minerals Showing Either Slight Advance or Decrease.

THE output of gold, silver, copper, lead and zinc from New Mexico ores in 1925 in terms of recovered and estimated recoverable metal was $552,000 in gold, 790,000 ounces of silver, 75,626,000 pounds of copper, 7,000,000 pounds of lead, and 17,700,000 pounds of zinc, according to Chas. W. Henderson, of the Bureau of Mines. These figures are to be compared with $512,735 in gold, 795,070 ounces of silver, 74,691,436 pounds of copper, 3,634,511 pounds of lead, and 20,759,200 pounds of zinc in 1924. These figures show that only one metal—lead—made much change. At present estimated average prices for gold, silver, copper, lead and zinc, the value of the output of these metals in 1925 was gold, $552,000; silver, $545,000; copper, $10,663,000; lead, $634,000, and zinc, $1,345,000. These values, together with that for gold, give a gross value of the output of $13,739,000, as compared with $12,470,119 for 1924, an increase of about $1,269,000 or 10 percent.

The predominant metal produced in New Mexico is copper. The value of the copper production for 1925 at one cent a pound increase over the average for 1924 was $10,663,000, as compared with $9,784,578 in 1924. The most prominent mining operation in New Mexico is that of the Chino mines of the Ray Consolidated Copper Co., with steam shovel pits and some underground workings at Santa Rita and a 12,000-ton flotation mill in seven units at Hurley. This mine produced in 1925 in the form of copper concentrates and copper smelting ore approximately 68,000,000 pounds of recoverable copper as compared with concentrates and ore in 1924, from which 66,574,486 pounds of refined copper was recovered. The copper production next in importance is that from the mines at Lordsburg, where a highly siliceous copper-gold-silver ore is shipped for furnace linings in copper smelting operations in Arizona and at El Paso, Texas. The Lordsburg district in 1924 produced 88,472 tons of ore, carrying in terms of recovered metals, 9,300 ounces of gold, 114,000 ounces of silver, 40,000 pounds of lead, and 4,900,000 pounds of copper. The Lordsburg district in 1925 produced 105,000 tons of ore of about the same assay content and recoverable content to the ton as in 1924. The third important copper operation is at Tyrone, where the Burro Mountain branch of the Phelps Dodge Co. continued leaching operations of low grade copper ore (hitherto known as waste) in surface dumps with slime sealed bottoms. In addition underground development work was done in 1925 at the Burro Mountain branch at the rate of about 400 feet a month.

The high price for lead, greatly stimulated the production of lead ores in New Mexico. All the well known lead-silver districts, some of them idle for several years, produced some lead.

Oregon

Lead Shows Increase, But Copper and Gold Show Decided Decrease.

THE value of gold, silver, copper, and lead produced in Oregon in 1925, according to the estimate of J. M. Hill, of the Bureau of Mines, was $429,088, a decrease of $248,984 as compared with the value of metals produced in 1924. The greatest decreases in value were in copper, which was 81 percent less, and gold, which was 30 percent less than in 1924. Lead was the only metal which showed an increase as compared with the previous year.

In 1925 it is estimated that 18,630 fine ounces of gold were produced in the state, valued at $385,116, as compared with 26,695 ounces, valued at $551,842 in 1924. The Cornucopia quartz mine and the Empire and Superior dredges were the largest producers of gold in the state. Apparently less gold than in 1924 was produced at the quartz mines in the Eastern-Oregon field and a little more than in 1924 was produced by quartz mines in southwest Oregon. The placer-gold yield was less because of decrease in the number of dredges.

The silver production of 1925, estimated at 34,930 fine ounces, valued at $24,102, was only 3,173 ounces less, and the value only $1,427 less than in 1924. Most of the silver was from silver and copper ores produced in eastern Oregon, though there was some high-silver ore shipped from southwest Oregon.

The Homestead-Iron Dyke, the only large producing copper mine in the state, was operated for only three months of 1925, so the copper production of the state was reduced to 132,500 pounds, valued at $18,683, as compared with 768,395 pounds valued at $100,660 in 1924. A few hundred pounds of copper was recovered from mixed concentrates shipped from eastern Oregon.

The lead yield in 1925 was 13,200 pounds, valued at $1,196, an increase of 12,687 pounds and of $1,146 in value as compared with 1924. Some lead ore was shipped from southwest Oregon, but the bulk of the lead was contained in mixed lead-copper concentrates produced in eastern Oregon.

Chief interest in eastern Oregon during 1925 was centered in the development of the copper deposits east of Baker, near Keating, on Powder River. A considerable amount of work was done at the Clover Creek, Goose Creek, and Poorman properties, and several other companies acquired ground along the Belt.

In southwestern Oregon there was a considerable amount of development at various deep mines, and more abundant water than for several years made placer work possible on a larger scale. In Jackson County the Gold Ridge, Millionaire, and Opp quartz mines were in operation and several pockets were taken out in various parts of the county. The Layton hydraulic mine and Ancient River placer were the principal producers of placer gold in the county. In Josephine County work was continued on the Almeda, Black Jack, and Mount Reuben mines, and several prospects at Galice. The Bunker Hill mine made a good production, and the Antler and Dean hydraulic mines were productive. A strike of importance was made at the Greenback mine, out from Leland. In the southern part of the county several quartz mines were further developed, notably the Siskron, near Holland. The Osgood placer property, near Waldo, changed hands, and the Esterly hydraulic properties were under development, looking to the elimination of hydraulic elevators. Some production was made in the Bohemia district, Douglas County, and ore was shipped from mines in the Elkhorn district, Marion County. Apparently there was not so much activity as usual on the beach deposits in Coos and Curry counties.

South Dakota

In 1925 the Homestake mine, the largest producing gold mine in the United States, and several small mines in South Dakota, produced approximately $5,950,000 in gold and 100,000 ounces of silver. In 1924 the Homestake mine and several small gold mines produced gold valued at $6,117,421 and 86,548 ounces of silver. As a result of work done at the Bureau of Mines Experiment Station at Reno, Nev., a method for successful treatment for the "blue" ores of the Portland-Trojan district, South Dakota, has been determined, and production may be renewed in that district in 1926.

Tonopah Mining Co., Tonopah, Nev.

Texas

Metal mines in Texas in 1925 produced 580,000 ounces of silver and nominal quantities of copper and lead. The greater part of the production came from the Presidio mine, at Shafter, Presidio County, a consistent producer since 1885.

Utah

Silver and Lead lead in record output. Gold and Zinc show large increase. Copper production slightly less.

The mines of Utah in 1925 produced gold, silver, copper, lead, and zinc valued at $82,763,000, an increase of nearly $16,000,000 over the output of 1924, according to estimates by V. C. Heikes, of the Bureau of Mines. The output of silver and lead exceeded that of any year since the mines were discovered, and the output of zinc and gold was decidedly larger than that of 1924. The quantity of copper, the most valuable output of the state, was slightly less than in 1924. Utah was the first in the United States in the production of silver, second in lead, and third in copper. Its lead output was greater in 1925 than that of Idaho, which has held second place for many years. One of the important features of the industry was the great progress made in the concentration of zinc-lead ore by differential flotation at International, Bauer, and Midvale.

The dividends paid by mining companies in Utah in 1925, as shown by published statements, amounted to about $12,454,946, exclusive of $2,492,232 paid by the United States Smelting, Refining & Mining Co., which controls mines at Eureka and Bingham, as well as mines in other states. The companies that contributed to this total were the Utah Copper, Tintic Standard, Silver King Coalition, Utah Apex, Park-Utah Consolidated, Park City Mining & Smelting, Chief Consolidated, Bingham Mines, Ohio Copper, and Mammoth.

Increase in Output of Gold

The production of gold increased about 21 percent, from $3,028,152 in 1924 to about $3,681,000 in 1925. Practically all the gold was recovered from ores and concentrates smelted, as the Tintic Standard Mining Co. was the only one that recovered any gold or silver in bullion or precipitates. Pronounced increases in the output of gold were made by the Park-Utah, Utah Apex, United States, and Chief properties, but there were large decreases from the Utah Copper, Utah, Delaware, and Centennial Eureka mines.

Record Silver Output

The output of silver increased from 17,253,692 ounces in 1924 to 21,177,000 ounces in 1925, thereby exceeding the former record of 1923 of 19,137,470 ounces. No neighboring state competes with Utah in silver output, and it produced more silver than Nevada, Arizona, and Colorado combined. The value of the output of silver increased from $11,559,974 to $14,613,000. There was a general increase in silver from Park City, Tintic, and Bingham, but the largest increase came from the Park City district, largely from the Park-Utah mine. The Tintic Standard Mining Co. was again the largest producer of silver in Utah, and it was followed by the Chief Consolidated, Park-Utah, Silver King Coalition, and Park City Mining & Smelting companies.

Slight Decrease in Output of Copper; Increase in Value

The production of copper decreased from 242,138,165 pounds in 1924 to 238,277,500 pounds in 1925, but the value increased from $31,720,100 to $33,621,000. Utah retained its place as the third producer of copper in the United States, as a result of operations of the Utah Copper Co., the largest producer. More ore was treated and the recovery in concentrate was much better in 1925, but the grade of milling ore was lower. The company produced nearly 18,000,000 pounds of copper a month. The Ohio Copper Co., continued to leach ore in place near Bingham, and made a large though decreased output of copper. The Utah Apex Co., became an important producer of copper, and other large producers were the Chief Consolidated, Silver King Coalition, United States, Utah Delaware, and Ophir Hill mines.

Highest Record Yet Made for Lead

The output of lead increased from 233,910,875 pounds in 1924 to 302,168,000 pounds in 1925, an increase of 27 percent and a record for the state. The value increased from $18,712,870 to $27,376,000 and the average price from 8 cents to about 9.06 cents a pound. The lead-smelting plants

Chino Branch of the Ray Consolidated Copper Company at Santa Rita, N. Mex.

at Midvale, Murray, and International were unusually active, and the shipments of lead bullion were greatly increased.

Increase in Output of Zinc

The zinc recovered from ore and concentrate leached or smelted increased from 18,562,172 pounds in 1924 to about 45,368,000 pounds in 1925, and the value from $1,206,541 to $3,470,000. A noteworthy increase was made from the ores of both Park City and Bingham, due in large part to the successful operation of the custom flotation plant at International, where mixed ores were reduced to lead concentrate smelted locally, and zinc concentrate which was shipped to Great Falls, Mont. The United States Co., at Midvale operated its wet mill and electrostatic plant, and also a small pilot flotation plant while the large flotation mill was under construction. At Bauer, the Combined Metals Reduction Co., treated zinc-lead ore largely from Nevada but partly from the Bullion Coalition property near Stockton, Utah. The United States property at Bingham retained its place as the largest zinc producer of Utah. It was followed by the Park City Mining & Smelting, Park-Utah, and Utah Delaware mines. The Utah Apex and Silver King Coalition companies not only shipped zinc material for milling, but made a first-class zinc concentrate at their own mills. Other zinc producers were the Bullion Coalition, Ontario, Chief Consolidated, Keystone (Park City), Utah Metal & Tunnel, Bingham Mines, Horn Silver, Godiva, Mammoth, New Bullion, and Scranton mines.

Production by Districts

In 1925 the mines in Utah produced about 14,090,000 tons of ore, an increase from 13,640,618 tons in 1924. Of this total the Bingham district produced about 13,088,000 tons, as compared with 12,708,560 tons in 1924. The estimated production of the district was 98,267 ounces of gold, 3,193,500 ounces of silver, 226,200,000 pounds of copper, 101,000,000 pounds of lead, and 22,770,000 pounds of zinc.

The mines of the Tintic district produced 444,000 tons of ore, much of which was dump material, as compared with 394,744 tons in 1924. The estimated production of the district was 30,663 ounces of gold, 8,599,000 ounces of silver, 2,427,000 pounds of copper, 76,656,000 pounds of lead, and 994,000 pounds of zinc. The mines that produced more than 10,000 tons of ore during the year were the Tintic Standard, Chief Consolidated, Victoria, Eagle & Blue Bell, Iron Blossom, Mammoth, and Plutus.

The shipments of ore, concentrate, and tailings from the Park City region increased from 183,427 tons in 1924 to 336,633 tons in 1925. The estimated output of the district was 17,138 ounces of gold, 7,345,500 ounces of silver, 2,100,000 pounds of copper, 78,561,000 pounds of lead, and 21,609,000 pounds of zinc. There was a marked increase in the ore mined as well as the metals recovered.

Mines in the Big and Little Cottonwood districts produced 12,906 tons of ore, containing 196 ounces of gold, 238,400 ounces of silver, 177,600 pounds of copper, and 4,351,000 pounds of lead. The large producers were the Cardiff, Columbus Rexall, Michigan Utah, and Emma mines.

From Ophir and Stockton shipments of lead ore and concentrate amounting to about 30,030 tons were made from the Ophir Hill, Stockton Lead, Keystone (Galena King), Bullion Coalition, and Hidden Treasure mines. Much lead ore and iron-arsenic ore was shipped from Gold Hill and considerable old tailings from Frisco.

Washington

More Copper, Lead, and Zinc Produced than in 1924; *Less Gold and Silver*

The value of the gold, silver, copper, lead, and zinc produced from ore mined in the State of Washington in 1925 was $1,064,000, as compared with $948,490 in 1924, according to estimates made by C. N. Gerry, of the Bureau of Mines. A good increase in the output of lead resulted from the high price of that metal, which averaged more than 9 cents a pound. A slight increase was also made in copper and zinc, but a decided decrease in gold and silver.

The production of gold decreased from $309,617 in 1924 to $208,641 in 1925. The Republic district produced the larger part of the gold, though several mines were idle and the district output was less than in 1924. The Knob Hill and Quilp properties produced monthly about 700 tons of siliceous ore, which was used in smelting at Trail, B. C. No ore was shipped from the Last Chance mine or from the property of the Northport Smelting & Refining Co. In Whatcomb County, the Brooks Willis Co. did only development work, but the Boundary Red Mountain Mining Co. resumed milling in June and shipped considerable bullion to Seattle, Wash.

The output of silver in the State decreased from 213,742 ounces in 1924 to 157,100 ounces in 1925. The Dominion Silver Lead Mining Co., near Colville, the largest producer of silver in the State, shipped several hundred tons of rich silver-lead ore, and stored lead-zinc ore for milling. Other producers of silver were the mines at Republic, the United Silver Copper Co., at Chewelah, and the Santa Rita mine, west of Springdale. Development work was continued at the Deer Trail mine, a large producer of silver in the past.

The output of copper increased from 928,458 pounds in 1924 to 1,200,000 pounds in 1925. The Sunset Copper Co., near Index, was the largest producer. Flotation concentrate containing some silver and copper was shipped to Tacoma, Wash. Several hundred tons of copper ore and concentrate containing silver was shipped by the United Silver Copper Co. at Chewelah.

The output of lead increased from 3,935,376 pounds, valued at $314,830 in 1924, to 5,552,200 pounds, valued at $503,000 in 1925. The Gladstone mine, near Northport, in Stevens County, upheld its record as the largest producer of lead in the State and The Gladstone Mountain Mining Co. reported paying regular dividends amounting to $72,710 during the year. Both sulphide and carbonate ore were shipped to the Bunker Hill Smelter at Bradley, Idaho. The Electric Point Co., an old lead producer, resumed shipments of similar ore in January. Lead concentrate from the Santa Rita mine, west of Springdale, decreased decidedly, but considerable rich lead ore was shipped from the Bella May and Grandview mines at Metaline, Pend Oreille County. Good progress in development and production was made at the Dominion mine near Colville, and a mill was being installed for the Chloride Queen mine on Clugsten Creek, north of Colville.

A slight increase was made in the production of zinc from the Black Rock and Blue Ridge properties near Northport. Ore and concentrate were shipped to Anaconda, Mont., Trail, B. C., and to Belgium.

HYDROMETALLURGY OF ZINC

In the course of a study of the hydrometallurgy of zinc, being conducted by the Bureau of Mines at Salt Lake City, Utah, work on acid leaching has been recessed, the problems of treating zinc silicate ores having been solved. This year's work on this problem will be confined to the more economical purification of zinc solutions by means of zinc amalgam, and methods for discarding some of the zinc solutions so as to allow more wash water to be added, so that the soluble zinc now being lost may be saved. Cooperative work is being done with commercial companies on the development of a complete process by which the zinc in a complex ore may be leached out with ammonia after roasting, precipitated as a basic carbonate and converted to an excellent grade of commercial zinc oxide in a furnace that is already built.

THE ANTHRACITE INDUSTRY IN 1925

General Strike In This Industry Has Caused A Deficit In Production Of About 23,500,000 Tons—Settlement Of The Question Of Anthracite Commercial Sizes Real Achievement—Industry Faces Serious Situation In Loss Of Markets If Strike Is Not Soon Settled

By E. W. PARKER*

AS in 1922 and 1923, the outstanding or spectacular part of the anthracite record for the year just ended was a general strike, which began September 1. The issues and incidents of the strike have been so thoroughly ventilated that it is useless to attempt a discussion of it as part of the year's record.

It is sufficient to say that the international union presented demands for large increases to what were already the highest wages paid in any basic industry in the world, and coupled with them additional demands covering working conditions which would have enhanced the cost, and the selling price, of anthracite to such a degree that the phrase "black diamonds" would no longer have been a figure of speech.

A continuance of operation at existing wages, with complete impartial arbitration of every issue, was offered to the union, but its leaders elected to strike at the termination of the two-year wage agreement August 31. The position of the industry has been explained in a comprehensive campaign of display advertising so that the most casual reader of the daily press, if interested, has had all the pertinent facts at hand.

The natural effect of the strike has been to cut production heavily. By the end of December the deficit in anthracite output had reached approximately 23,500,000 gross tons. In 1924 the total output was 78,506,127 gross tons, of which 68,970,981 tons were shipped, 2,717,803 tons sold locally, and 6,817,343 tons used for power at the mines. For 1925, Government agencies give the total production as approximately 55,000,000 gross tons.

This shows a deficit of about 23,500,000 gross tons, but the figure may vary a little in that the consumption of coal at the mines has not been as large during the strike period as it would be under normal working conditions. It is true there is no power being expended in hoisting or preparing coal, but water is being removed right along, and as at least 11 tons of water are pumped or hoisted for every ton of coal under normal conditions, it will be seen that the saving due to lack of production is not so very marked. Of course the idleness of the breaker machinery substantially cuts down colliery fuel consumption.

Government reports show "anthracite production" for each month during the strike, but this coal is all dredge product recovered from the creeks and rivers in or near the region, and it is all small size. There has been no coal mined or recovered from culm banks by regular washeries since September 1.

According to the United States Geological Survey, the total production of anthracite in gross tons during the ten years from 1915 to 1924, has been as follows:

	Shipped Gross tons	Sold Locally Gross tons	Used at Mines Gross tons	Total Gross tons
1915..	68,666,456	1,867,934	8,925,486	79,459,876
1916..	67,501,363	1,978,649	8,715,071	78,195,083
1917..	77,490,043	2,127,109	9,321,965	88,939,117
1918..	76,721,157	2,387,892	9,128,526	88,237,575
1919..	67,972,295	2,107,876	8,573,580	78,653,751
1920..	68,610,763	2,586,163	8,801,511	79,998,437
1921..	69,554,563	2,511,206	8,714,098	80,779,867
1922..	41,073,838	2,123,393	5,626,896	48,824,127
1923..	73,427,712	2,900,314	7,010,375	83,338,401
1924..	68,970,981	2,717,803	6,817,343	78,506,127

Eliminating the colliery consumption and the fuel recovered from old culm banks by washeries and from river and creek beds by dredges, and considering only the commercial production of freshmined anthracite, the record for the six years ending with 1924, as reported by the United States Geological Survey, has been as follows. The figures for 1925 are, of course, not available.

	Commercial production gross tons	Value at mines	Average value per ton at mines
1919.....	66,444,325	$343,085,589	$5.163
1920.....	65,875,070	402,657,859	6.112
1921.....	70,191,076	437,488,640	6.233
1922.....	39,768,901	255,574,915	6.426
1923.....	71,718,088	482,404,160	6.726
1924.....	69,906,363	466,720,562	6.676

The chief interest in this table is that it refutes definitely the statement, several times repeated, by the governor of the state that the advances in price on the domestic sizes to cover the cost of his increase in 1923 of 10 percent to the miners were unwarranted. The anthracite producing companies actually realized 5 cents a ton less in 1924 than in 1923, and absorbed all of the enforced increased cost.

There has been no real menace to the consuming public by reason of the anthracite strike; that is, there has been no reason to think that anybody would have to suffer for lack of fuel. Substitute fuels are in abundant supply, the principal ones being coke and low volatile soft coal, with fuel oil naturally profiting to a great extent at the expense of anthracite.

But while the public has not great reason to worry, the anthracite industry itself—and this includes the mine workers as well as the mine operators—has cause for grave concern. With a shortage of 23,500,000 tons of anthracite in 1925 to be made up by substitute fuels, and with the major part of the coal-burning season still to come, hard coal faces the likelihood that a substantial part of its trade will be weaned away permanently. This likelihood would be turned into a certainty should the strike be settled on any basis which would necessitate further increase in the price of domestic coal.

Many years ago the backbone of the anthracite demand was with the iron furnaces along the Susquehanna, Lehigh and Schuylkill rivers. Long and frequent coal strikes from the close of the Civil War until the great strike of 1875 disgusted the iron men and sped up the replacement of anthracite by coke as furnace fuel. The strike is a dangerous tool to employ, and there is historic precedent which at least shows the possibility of the present senseless idleness inflicting injuries whose scars will last a long time.

There has been social and commercial effects in the anthracite regions themselves which have perhaps been little noted by the outside world. Since April 1, 1922, a period of 44 months, the mine workers have been idle at least 10 months through general strikes—nearly 25 percent of the time. Careful calculations have indicated that, even allowing for the 10 percent increase which Governor Pinchot bestowed upon the miners in 1923 at the expense of the general public, the net loss in wages to the mine workers have averaged not far from $1,000 per man. The aggregate loss is in excess of $150,000,000 which is a considerable figure even in these days of quick and large fortunes in Florida real estate.

Among the unfortunate or improvident in the anthracite region there has been want and even suffering. Charitable persons, organized and unorganized, have done much to alleviate conditions, and coal companies themselves have come to the assistance of their striking employes, that non-combatants, innocent women and children should not suffer for lack of warmth and food. It will need a strong back and a tough conscience to bear the burden of moral responsibility for this strike.

Based on the totals of the payrolls for 1924 (approximately $325,000,000) the mine workers had suffered a loss in wages in the four months from Septem-

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ber 1 to December 31, of over $100,000,000. In the 5½ months' idleness of 1922 the loss in wages amounted to not less than $130,000,000. If the 1922 wage scale had been in effect in 1925 the mine workers would have lost by the present strike $90,000,000 instead of $100,000,000. The short suspension in 1923 (which was "compromised" by Governor Pinchot with a flat increase of 10 percent) cost about $10,000,000 in wages. Idleness due to unnecessary suspensions, not to mention outlaw strikes, has therefore cost the anthracite mine workers in less than four years $230,000,000. They gained in the last two years by the Pinchot "compromise," based on the 1921 payrolls, between $55,000,000 and $60,000,000. In other words, if there had been no suspensions in 1922, 1923, and 1925, and no increase in the 1922 wage scale, the mine workers would have been between $170,000,000 and $175,000,000 better off on January 1, 1926, than they actually were including the Pinchot 10 percent increase in 1923.

Constructive policies of the industry, working through the Anthracite Operators' Conference, have been continued during the year. Work designed to instruct the public in the merits of small sizes of anthracite as cheap and satisfactory household fuel, has been expanded as far as conditions allowed. Advice from competent combustion engineers as to the right size of fuel to buy and the way to use it to get best results has been afforded by the Anthracite Coal Service, this service being free.

When it became apparent that the strike was going to continue and that anthracite consumers in many cases would have to use substitutes, these combustion engineers added to their activities the instruction of householders in the proper method of using low volatile bituminous coal, and some of them were detailed to public stations where the use of soft coal was demonstrated. As part of this service to the public the operators advertised extensively their advice to use soft coal as a substitute, and they printed detailed instructions for its use.

A genuinely constructive development of the year was the action taken by the Anthracite Operators' Conference early in the spring to settle the question of anthracite commercial sizes, which has been a source of friction and worry for many years. The conference, in an endeavor to effect uniformity in the sizing and preparation of coal, made recommendations for standardization to become effective April 1, sizes to be as follows, all meshes being round:

Size	Through	Over
Broken	4 7/16	3 7/16
Egg	3 7/16	2 8/16
Stove	2 8/16	1 9/16
Chestnut	1 9/16	11/16
Pea	11/16	8/16

While screens of the above sizes were recommended for testing purposes, variations of the screens actually used in the breakers naturally persist to provide for differences in the fracture of coal, the idea not being to have exactly the same screens in each breaker but to assure that in any given size the same sort of coal should come from all breakers. This action on the part of the operators was taken at the request of representatives of retail dealers and after careful tests which demonstrated that anthracite consumers would be protected from any lowering of quality or efficiency in their domestic fuel.

It was further recommended that the permissible percentage of bone and slate should vary from 2 percent to 7.5 percent, according to size, and that 15 percent of undersize coal in any size should be the maximum, save in Chestnut where 5 percent additional cares for unavoidable breakage. Retail dealers, with whom sizing has been a tender point for a long time, gave general approval to the suggestions, as did the trade publications.

INCREASING LUMP COAL PRODUCTION

AS A RESULT of a study of various factors affecting the production of lump coal, the percentages of lump obtained in a typical coal mine in western Pennsylvania by investigators of the Bureau of Mines and the Carnegie Institute of Technology was increased from 56.5 to 65 percent in wide face workings. This increase of 8.5 percent in lump coal production was achieved by changes in the explosive used and in the blasting practices followed.

In this investigation five general factors involved in the production of lump coal were studied quantitatively. In the first of these, five permissible explosives of different physical characteristics were used under similar conditions of working. A difference of 4.7 percent of lump coal resulted from changing the explosive used.

Studies were then made of the effect of varying the width and direction of the working place relative to the face cleat. The lowest percentage of lump coal was produced in the narrow butt working, increasing in other working places in the following order: wide butt workings, narrow face workings, and wide face workings. There was a difference of 5.1 percent between the poorest and best conditions.

The placement of holes was the next factor taken up. By changing from the standard practice of drilling the hole (24 inches below the draw-slate slanted upward at the rate of 3 inches per foot of drillhole) to one in which the hole was placed 10 inches below the draw-slate and drilled at slant of about ½ inch per foot of drillhole, an increase of 5.1 percent was obtained. The most desirable distance from the rib was fixed at 12 inches as a result of these tests.

Snubbing of the coal was investigated with the usual placement of holes as well as with flatter holes, but no advantage was found in either case.

By using rock dust for stemming in holes slanting upward an increase of 4.5 percent was obtained. With the rock-dust stemming in flat holes a further increase of 1.4 percent was obtained, of which only 0.8 percent can be attributed to rock dust.

It is only within recent years that any technical study has been made of the methods of blasting coal, it is pointed out. As part of the Bureau of Mines investigation of the fundamental factors in breaking down coal at the face, J. E. Tiffany and C. W. Nelson in 1923 and 1924 conducted tests in cooperation with the Hillman Coal & Coke Co., in its Naomi mine at Fayette City, Pa. As a result of the investigation in the Naomi mine, the percentage of 1¼-inch lump coal was increased from 64 to 71½ percent by air-spacing with snubbing after the coal was undercut. J. E. Tiffany and J. J. McKitterick, in a mine in Southern Illinois producing 4,000 tons per day, increased the 6-inch lump from 11 to 13 percent, based on the entire production.

Therefore, a consideration of these various investigations emphasizes the importance of standardizing drilling and blasting practices; close supervision; not gripping the undercut at the ribs; cleaning out the bug dust from the undercut; loading out all coal after each shot; placing holes properly; avoiding the overloading of holes with explosives, and properly tamping the holes with incombustible stemming.

The results of the present series of tests, made by J. E. Tiffany, explosives testing engineer, Bureau of Mines, and B. L. Lubelsky, research fellow, Carnegie Institute of Technology, are given in Bulletin 19, "Coal Mining Investigations," copies of which may be obtained from the Carnegie Institute of Technology, Pittsburgh, Pa., for $1.00.

FIRST-AID TRAINING IN ALASKA

THE interest and enthusiasm being manifested by mine operators and miners in Alaska in the first-aid and training work of the Bureau of Mines, is evidenced by the fact that 141 men, constituting 33 percent of the total employees of the Kennicott Copper Corporation, have recently taken the training. At the Erie mine of this company 17 men, representing 100 percent of the employees, received first-aid instruction from Russell G. Thornburg, foreman miner, Mine Rescue Car No. 11.

IRON ORE PRODUCED IN 1925

Fourteen Percent Increase Shown By Bureau Of Mines Estimates—85 Percent Of Ore Shipped By Lake Superior District—Exports Greater For 11 Months' Period Than Entire Year 1924

THE iron ore mined in the United States in 1925, exclusive of ore that contained more than 5 percent of manganese, is estimated by Hubert W. Davis, of the Bureau of Mines, at 62,079,000 gross tons, an increase of 14 percent as compared with that mined in 1924. The ore shipped from the mines in 1925 is estimated at 63,819,000 gross tons, valued at $159,363,000, an increase of 23 percent in quantity and of 5 percent in total value as compared with the figures for 1924. The average value of the ore per gross ton at the mines in 1925 is estimated at $2.50; in 1924 it was $2.91. The stocks of iron ore at the mines, mainly in Michigan and Minnesota, apparently decreased from 12,410,619 gross tons in 1924 to 10,774,000 tons in 1925, or 13 percent. The considerable increase in output may be ascribed in part to a better demand for steel and to general speeding up in pig-iron manufacture during 1925. The decrease in the average value of iron ore at the mines of 41 cents a ton was largely due to the lowering of base prices of Lake Superior iron ores 50 cents a ton for the season of 1925. Lesser decreases in values occurred in all the other groups of States.

These estimates are based on preliminary figures furnished by producers of about 99 percent of the normal output of iron ore. They show the totals for the principal iron-ore producing States, and, by grouping together certain States, the totals for the Lake Superior District and for groups of Southeastern, Northeastern, and Western States.

Lake Superior District

About 85 percent of the iron ore shipped in 1925 came from the Lake Superior district, in which approximately 52,316,000 gross tons were mined and 54,124,000 tons were shipped, increases of 16 and 26 percent, respectively, as compared with the quantities mined and shipped in 1924. The ore shipped in 1925 was valued at $138,061,000, an increase of 5 percent. These totals include the ore from the Mayville and Baraboo mines in Wisconsin and ore shipped by rail as well as by water from all mines, but exclude manganiferous ores that contained more than 5 percent of manganese. The ore is chiefly hematite. The stocks of iron ore in this district apparently decreased from 11,095,787 gross tons in 1924 to 9,398,000 tons in 1925, or 15 percent. The stocks at the end of 1925 were about 1,069,000 tons less than the average for the preceding five years. The shipments of iron ore by water from the Lake Superior district in 1925 (including manganiferous iron ores), according to the Lake Superior Iron Ore Association, amounted to 54,081,296 gross tons, an increase of 27 percent as compared with these shipments in 1924. The average value of the ore at the mines in the Lake Superior district in 1925 was $2.55; in 1924 it was $3.04.

The mines in Minnesota furnished 70 percent of the total iron ore shipped from the Lake Superior district in 1925 and 59 percent of the total of the United States. The mines in Michigan furnished 28 percent of the Lake shipments and 24 percent of the grant total.

Southeastern States

The Southeastern States, which constitute the second largest iron-ore producing area, including the Birmingham and Chattanooga districts, mined approximately 7,510,000 gross tons of iron ore in 1925, an increase of 1 percent as compared with 1924. The shipments of iron ore from these States to blast furnaces in 1925 amounted to 7,262,000 gross tons, valued at $15,623,000, an increase in quantity of 3 percent and in value of 2 percent as compared with the quantity and value of shipments in the previous year. The ore consists mainly of hematite; brown ore and magnetite come next in order. The average value of the ore produced in these States in 1925 per gross ton was $2.15; in 1924 it was $2.18. Conditions in the Birmingham district, Alabama, seem to have been more favorable during the year than in other parts of the South. The stocks of iron ore at the mines in this group of States, mainly in the Birmingham district, increased from 750,514 gross tons in 1924 to 1,001,000 tons in 1925. These stocks are about 465,000 tons more than the average for the preceding five years.

Open cut operations on the Mesabi Iron Range

Northeastern States

The Northeastern States, which include the Adirondack district, New York, and the Cornwall district, Pennsylvania, in 1925 mined 1,302,000 gross tons of iron ore and shipped 1,482,000 tons, valued at $4,082,000, increases of 15 percent in the quantity mined, 22 percent in the quantity shipped, and 9 percent in value of shipments as compared with 1924. Production in the Adirondack district was on a reduced scale during 1925, the greater part of the ore shipped having been withdrawn from mine stock piles. The stocks of iron ore in this group of States decreased from 552,153 gross tons in 1924 to 363,000 tons in 1925. These stocks are considerably less than usually carried over at these mines, being about 284,000 tons below the average for the preceding five years. The average value of the ore in these States in 1925 per gross ton was $2.75; in 1924 it was $3.09. Most of this ore is magnetite.

Western States

The Western States that ordinarily produce iron ore named in the order of their importance, are Wyoming, Utah, New Mexico, Montana, Colorado, and California. Occasionally Idaho, Nevada, and Washington, contribute small quantities. All the ore from Wyoming, New Mexico, and Colorado, and most of that from Utah, is used for the manufacture of pig iron. Much of the remainder is used as a flux in smelting copper and the precious metals. It is estimated that the Western States mined and shipped in 1925 approximately 951,000 gross tons of iron ore, valued at $1,597,000, an increase of 31 percent in quantity and and of 27 percent in value as compared with 1924. The ore comprises hematite, magnetite, and brown ore. The increase in output in this group of States in 1925 reflects the more active operations at mines in the Iron Springs district, Utah, and in the Hartville district, Wyoming.

Imports and Exports

The imports of iron ore reported for the eleven months ended November 30, 1925, amounted to 1,950,648 gross tons, valued at $6,396,425, or $3.28 a ton. The imports for the year 1924 were 2,047,055 gross tons, valued at $10,580,904, or $5.17 a ton. The reported (*Continued on page* 98)

PRELIMINARY REPORT ON THE MANGANESE SITUATION IN 1925

Manganese Ore Production Increases 73 Percent—Manganiferous Iron Ore Production Shows 100 Percent Increase

ACCORDING to preliminary figures compiled by the Bureau of Mines for 1925, the domestic shipments of manganese ore containing 35 percent and more of metallic manganese totalled approximately 97,500 tons, valued at $1,853,000. This is an increase of 73 percent over 1924; the tonnage produced in 1924 was 56,515, valued at $1,307,477. The difference in value of the two years as given is due to the fact that the ratio of the production of chemical ore to that of metallurgical ore decreased, while the production of chemical ore remained relatively constant for the two years.

In 1925, the Butte, Mont., district shipped 47,856 tons of manganese ore. This ore was rhodochrosite and was utilized in the manufacture of ferro-manganese.

Very large increases were made in shipments of high grade manganese ore from Montana and Virginia with smaller increases from Washington, New Mexico and Georgia. The most notable decrease for the year was that which occurred in Colorado. After May, 1925, only one company was active in the Leadville, Colo., district and its production was manganese ore and manganiferous ores.

Figures furnished by the Bureau of Foreign and Domestic Commerce show that during the first eleven months of 1925, the metallic manganese content of the manganese ore imported amounted to 242,009 tons. The imports from Cuba for eleven months are given as 8,182 tons of manganese ore. For the first eleven months the manganese content of the imports of ferro-manganese and other alloys exclusive of spiegeleisen was given as 68,164 tons. Assuming an average of manganese content of 48 percent for all ores imported, the gross weight of ore imported, including that of Cuba, during this period was approximately 512,000 tons. If the imports in December were equivalent to those in November then the total would be about 582,000 tons as compared with 505,000 tons in 1924, calculated on the same tenor of ore. The 1924 imports of ferro-manganese (manganese content) were 45,270 tons. The metallic manganese in the imports of ore from the Caucasus (Russia) amounted to 89,994 tons for the first eleven months of 1925, over double the quantity imported for the entire year of 1924, namely, 41,097 tons of metallic manganese. This difference is partially made up by the fact that no imports for 1925 can be credited to Turkey, while in 1924, 52,557 tons were reported from that country which should have been credited to the Caucasus for 1924. The imports of ore from Brazil for the first eleven months of 1925, contained 87,229 tons of manganese as compared with 54,938 tons for the entire year of 1924; imports from British India show a decided decrease for 1925, figures being 22,873 tons imported for the first eleven months of 1925 as compared with 54,566 tons for the entire year of 1924; imports from Gold Coast of West Africa (British) for the first eleven months of 1925 were 31,750 tons as compared with 23,034 tons in 1924.

The large increase in imports of manganese during the year 1925, was in large part consequent to the increase in the production of steel.

The shipments of domestic ores carrying from 10 to 35 percent manganese decreased in 1925, from 286,470 tons, valued at $929,390, to approximately 265,000 tons, valued at $827,000. The decrease is due to the large falling off in production in Colorado and Minnesota, whereas in Michigan and New Mexico decided increases were made.

The domestic shipments of ores containing 5 to 10 percent manganese show an increase over 1924 production of nearly 100 percent. The consumption of manganiferous iron ores for use in blast furnace practice is responsible for this increase. The shipments of this class of ore amounted to 1,156,000 tons in 1925, valued at $2,815,000 compared with 587,026 tons in 1924, valued at $1,713,943. The shipments from Minnesota increased from 361,527 tons in 1924, to 742,000 tons in 1925, and those from Wisconsin from 175,316 tons to 404,213 tons.

IRON ORE PRODUCED IN 1925

(*Continued from page 97*)

exports of iron ore for the eleven months ended November 30, 1925, amounted to 629,572 gross tons, valued at $2,409,015, or $3.83 a ton, as compared with exports for the entire year 1924 of 595,413 tons, valued at $2,407,003, or $4.04 a ton. These statistics of imports and exports were compiled from the records of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce.

The following table shows the quantity and value of the iron ore mined and shipped in the United States by the principal producing States. The figures for 1924 are final, but those for 1925 are subject to revision.

Estimates of Iron Ore mined and shipped in the United States in 1925 and actual output in 1924

District	Ore mined (gross tons) 1924	Ore mined (gross tons) 1925	Ore shipped 1924 Gross tons	Ore shipped 1924 Value	Ore shipped 1925 Gross tons	Ore shipped 1925 Value
Lake Superior:						
Michigan	12,350,755	14,500,000	11,248,641	$35,605,902	15,218,000	$40,172,000
Minnesota	31,902,085	37,000,000	31,076,114	93,311,092	37,970,000	95,608,000
Wisconsin	690,058	816,000	786,006	2,044,762	936,000	2,281,000
	44,942,898	52,316,000	43,110,761	$130,961,756	54,124,000	$138,061,000
Southeastern States:						
Alabama	6,993,613	7,125,000	6,557,596	$13,927,551	6,896,000	$14,698,000
Georgia	113,039	111,000	112,059	285,128	112,000	314,000
Missouri	79,847	40,000	79,847	405,622	40,000	148,000
North Carolina	12,525	24,000	12,525	32,512	24,000	53,000
Tennessee	179,853	133,000	179,293	431,682	133,000	282,000
Virginia	89,792	77,000	91,759	250,279	57,000	128,000
	7,468,669	7,510,000	7,033,079	$15,332,774	7,262,000	$15,623,000
Northeastern States:						
New Jersey	65,197	202,000	101,123	$420,488	163,000	730,000
New York	255,832	134,000	303,386	1,448,616	394,000	1,892,000
Ohio	244	2,000	244	1,881,366	2,000	1,460,000
Pennsylvania	807,208	964,000	807,411		923,000	
	1,128,481	1,302,000	1,212,164	$3,750,470	1,482,000	$4,082,000
Western States	727,371	951,000	727,371	$1,262,105	951,000	$1,597,000
Grand total	54,267,419	62,079,000	52,083,375	$151,307,105	63,819,000	$159,363,000

NEUMANN BANDS IN STEEL

THE object of a study of Neumann bands in steel, being conducted at the Pittsburgh, Pa., experiment station of the Bureau of Mines, is to determine whether breakage of steel, caused by an explosion, can be identified by a study of the Neumann bands produced, and also to determine to what extent metal is weakened by Neumann bands. The solubility of specimens, containing Neumann Bands, in 50-50 hydrochloric acid and water, was found to increase with increase in Neumann bands and with increase in velocity of explosion, but more work is needed to determine the exact effects on solubility. It is planned to determine how austenitic steels are affected by explosive impact, how heat-treatment affects the characteristics of Neumann bands, and to what extent the physical properties are changed by the presence of Neumann bands.

LEAD AND ZINC IN 1925

Ten Percent Increase In Smelter Output Of Lead And Zinc, Slightly Larger Gain In Mine Output, Shown By Bureau Of Mines Estimates

THE output of soft lead by mines of the Mississippi Valley and the Eastern States during 1925 was about 313,000 short tons, and that of argentiferous lead by mines of the Western States was about 367,000 tons, a total of 680,000 tons, according to the Bureau of Mines. The corresponding figures for 1924 were 284,972 tons from the Mississippi Valley and the Eastern States and 310,933 tons from the Western States. The southeastern Missouri district made the largest output, about 205,000 tons, as compared with 187,737 tons in 1924. Utah ranked second in output, with about 151,000 tons, an increase of nearly 30 percent over the output of 1924; Idaho ranked third, with about 130,000 tons.

The imports of lead in ore for eleven months amounted to 40,680 tons. More than two-thirds of these imports came from Mexico. The content of lead in ore and base bullion in bonded warehouse on November 30 was 95,315 tons.

The price at Joplin of 80 percent lead concentrates was $137.50 a ton at the beginning of the year. It rose to $146 by the middle of January. In the following week a decline began and the price had fallen to $90 by the middle of April, where it remained for several weeks. The price ranged from $100 to $130 in the following months and closed the year at $115 a ton.

The output of primary domestic desilverized lead was about 345,000 tons; of soft lead about 255,000 tons, and of desilverized soft lead about 51,000 tons, making a total output from domestic ores of about 651,000 tons of refined lead. Corresponding figures in 1924 were 299,343 tons of desilverized lead, 203,615 tons of soft lead, and 63,449 tons of desilverized soft lead, making a total of 566,407 tons. The output of lead smelted and refined from foreign ore and bullion was about 112,000 tons, as compared with 124,086 tons in 1924. The total lead smelted or refined in the United States in 1925 was thus about 763,000 tons, as compared with a total of 690,493 tons in 1924—a gain of about 10 percent. The output of antimonial lead in 1925 was about 17,000 tons, as compared with 20,787 tons in 1924.

The imports of refined pig lead in the first eleven months of 1925 were 5,699 tons. Nearly 90 percent of this lead came from Mexico. The base bullion imported in eleven months of the year contained 60,913 tons of lead, of which 99 percent came from Mexico. The lead of foreign origin exported in eleven months amounted to 93,292 tons, as compared with 76,758 tons in 1924. Lead of domestic origin exported in the same period amounted to 3,853 tons, as compared with 5,332 tons in 1924. From a total supply of about 774,000 tons of refined lead (exclusive of stocks) there was withdrawn for export or remained in warehouse about 109,000 tons, leaving 665,000 tons available for consumption in the United States, as compared with 602,947 tons in 1924.

The average quoted price of lead for prompt delivery at New York for the year was 9.1 cents a pound, as compared with an average selling price of 8 cents in 1924. The following were the average prices of lead by months during the year, in cents a pound:

January	10.3
February	9.4
March	8.9
April	8.0
May	8.2
June	8.4
July	8.3
August	9.8
September	9.6
October	9.7
November	9.8
December	9.4

Zinc Mining and Smelting

The recoverable zinc contained in ore mined in 1925 was about 712,000 tons, as compared with 636,617 tons in 1924. The output of the Eastern States was about 115,000 tons (78 percent from New Jersey), of the Central States about 457,000 tons, and of the Western States about 140,000 tons. Notable increases were made in the zinc output of Utah and Idaho.

The imports of zinc in ore for eleven months amounted to 11,806 tons. The zinc content of concentrates exported during eleven months of the year amounted to 60,784 tons. The zinc content of zinc ore in bonded warehouse on November 30 was 18,735 tons.

The price at Joplin of 60 percent zinc concentrates was $57.50 a ton at the opening of the year. The price dropped to $47.50 in April and May but rose gradually in the following months and reached $59 in November. The quotation at the end of the year was $56 a ton.

The output of primary metallic zinc from domestic ores in 1925 was about 551,000 tons and that from foreign ores was about 18,000 tons, a total of 569,000 tons, as compared with 515,831 tons from domestic ores and 1,508 tons from foreign ores, a total of 517,339 tons in 1924. In addition to the output of primary zinc there was an output of about 39,000 tons of redistilled secondary zinc, as compared with 35,486 tons in 1924, making a total supply of distilled and electrolytic zinc in 1925 of about 608,000 tons, composed of 157,000 tons of high grade and intermediate, 83,000 tons of select and brass special, and 368,000 tons of prime western zinc. Of the total output of primary zinc in 1925 about 109,000 tons was made in Illinois, 135,000 tons in Oklahoma, and 102,000 tons in Pennsylvania. The remainder was made in Arkansas, Indiana, Kansas, Montana, Texas, and West Virginia.

The imports of foreign slab zinc for eleven months amounted to only 21 tons. The exports of slab zinc made from domestic and foreign ores amounted to 77,735 tons, including 3,765 tons of rolled zinc. The stock of zinc reported at smelters at the end of November was about 8,000 tons. No slab zinc was reported in warehouse. The apparent consumption of primary zinc in 1925 was about 504,000 tons, as compared with 448,257 tons in 1924.

Out of a total of 121,000 retorts at plants that had operated during all or a part of the year, about 91,000 were reported in operation at the end of November. The number expected to be in operation December 31 was about 97,000.

The average quoted price of prime western zinc at St. Louis in 1925 was 7.6 cents a pound, as compared with an average selling price for all grades in 1924 of 6.5 cents. The price of prime western zinc at the beginning of the year was 7.82½ cents a pound. The lowest price quoted during the year was 6.77½ cents, on May first. The following were the average prices of zinc by months during the year, in cents a pound:

January	7.8
February	7.5
March	7.3
April	7.0
May	7.0
June	7.0
July	7.2
August	7.6
September	7.8
October	8.3
November	8.7
December	8.7

LEAD SMELTER SLAGS

A BRIEF survey of local lead smelters operating in the southwest will be conducted by the Bureau of Mines during the coming year. The object of this survey is to collect data showing the research problems on which work should be done. A similar survey of copper smelters in the southwest was made by the Tucson, Ariz., experiment station of the bureau. As lead slags require closer manipulation and the losses of lead are greater than with copper slags and the forms in which it is lost may permit of mechanical means of recovery, reasons exist for believing such a survey would be profitable.

ARSENIC IN 1925

THE production and sales of arsenic in the United States in 1925 nearly equalled the large output made in 1924, according to Victor C. Heikes, of the Bureau of Mines. Four companies that produced white arsenic in the United States in 1925 reported sales which amounted to about 12,000 short tons and sold at from 3 to 6 cents a pound. The quantity sold is nearly equal to the total white arsenic produced. About 8,000 tons was reported in stock at the end of the year.

During 1925 about 9,000 tons of white arsenic were imported into the United States as shown by actual figures for ten months and an estimate for the remainder of the year.

Over 1,000 tons of white arsenic were imported in January and in June; during the other months imports averaged around 750 tons. Most of the imported white arsenic came from Mexico and from ports in Germany and lesser amounts came from Canada, Japan, and Southern Rhodesia. The total available white arsenic in the United States during 1925 therefore amounted to about 29,000 short tons.

Most of the white arsenic was used in the manufacture of insecticides and for weed killer. Very little calcium arsenate was manufactured for controlling boll weevil during 1925 as the ravages of that pest had far less effect on this year's cotton crop than on previous crops. The manufacturers of weed killer used about 4 pounds of white arsenic to the gallon of solution of which over a million gallons were sold.

The producers of white arsenic in the United States in 1925 were the American Smelting & Refining Company, United States Smelting, Refining & Mining Company, Anaconda Copper Mining Company, and the Jardine Mining Company.

The price of white arsenic in 1925 as quoted in journals published in New York City ranged from 5¾ cents in January, 4¾ cents in July, 3¾ cents in September and 3¼ cents a pound in December with only an occasional carload being sold.

SLATE IN 1925

THE value of the slate sold at the quarries in 1925 was $12,785,000, according to the estimates furnished by producers to the Bureau of Mines. This was 9 percent more than the value reported for 1924. Slate reported sold for roofing, blackboards, and granules and flour showed increase in both quantity and value, while the other products decreased.

The roofing slate sold amounted to 477,000 squares, valued at $4,900,000, an increases of 2 percent in quantity and 6 percent in value. There was an increase of 41 cents in the average value per square.

The total sales of mill stock amounted to 10,405,000 square feet, valued at $4,110,000, an increase of 4 percent in quantity and 5 percent in value. Sales of mill stock for blackboards was the only variety of mill product that showed increased sales—23 percent in quantity and 39 percent in value. The estimated output was 5,000,000 square feet, valued at $1,596,000.

Sales of structural slate—2,276,000 square feet, valued at $880,000—decreased 3 percent in quantity. Sales of electrical slate, estimated at 1,654,000 square feet, valued at $1,355,000, decreased 8 percent in quantity.

In 1925 as in 1924 strikes in some of the quarries in the Pennsylvania district had the effect of curtailing the output of roofing slate and all classes of mill stock. There were also strikes in the quarries of the New York-Vermont district. The general demand for roofing slate was as good or better than in 1924 during the first part of the year, and prices were reported higher in 1925. The demand for structural and electrical slate increased toward the latter part of the year. The demand for blackboard material was exceptionally good until abqut October when it slowed down considerably.

The sales of crushed slate for roofing granules and flour in 1925 was estimated at 540,000 short tons, valued at $3,685,000, an increase of 5 percent in quantity. The average value per ton was somewhat higher than in 1924.

RATE OF REDUCTION OF IRON OXIDES

THE object of a study of the rate of reduction of iron oxides being conducted by the Bureau of Mines, is to obtain results of use in the design and operation of the blast furnace. Although the methods of physical chemistry are employed in the experiments, the possibility of applying the results to practical furnace problems is kept in the foreground. Experiments during the past year have shown what are the important temperatures, rates of flow, sizes of particles and apparent densities of ore mass. The percentage of voids between the ore particles was found to affect the reaction rate. The degree of oxidation of the ore also has been found to be of great importance. The reduction rate has been followed from analyses of the gas flow into and out of the heated ore beds, and by the composition of the ore after each test. A third method for measuring reduction, involving a determination of the magnetic susceptibility of the ore, is being developed.

HEAT TRANSFER IN BLAST FURNACE

THE most important function of the ascending gas in the iron blast furnace is probably the reduction of the ore to metal. The gas, however, has a second duty to perform, the heating of the descending solids. The physics of this heat transfer from gas to colder solid particles is being investigated by the Bureau of Mines, with the view that furnace designers may know how best to satisfy the thermal requirements of the blast furnace process.

Preliminary experiments at the North Central Experiment Station of the Bureau, at Minneapolis, have shown that the coefficient of thermal transmission is high and depends upon the screen-size, the rate of flow, the percentage of voids between particles, and the temperature. In general, heat transmission is a function of the physical properties of the ore mass similar somewhat to the rate of reduction and to the pressure drop experienced by the gas flowing through the ore. The three interrelated problems depend directly upon the mechanics of the molecular contact at the interface between the gas and solid phases.

VENTILATION FACTORS IN MINES

IN order to supplement past laboratory experiments and tests in the Experimental Mine under controlled conditions, on the kind and amount of pressure losses in air currents, field studies of ventilation are being conducted in metal and coal mines by the Bureau of Mines. The work for the current year is being centered at Butte, Mont. Engineers of the Bureau of Mines, in cooperation with officials of metal mines at Butte, have just completed an extensive study of friction factors in metal mine airways, which has yielded fundamental data that have been computed into tables and charts that can be directly applied by the ventilation engineer in estimating power or fan requirements for insuring that the volume of air delivered at the face will be adequate. Work was also completed on ventilation tests in an Indiana coal mine, showing friction losses in rough airways compared with smooth-walled entries.

REFRACTORY MINERALS IN CYANIDE PRACTICE

THE principal nonsoluble loss in present cyanide practice appears to be due to precious metals associated with antimony-arsenic minerals. In order to determine their effect in cyanide practice, a study of antimony-arsenic and other refractory minerals and their decomposition products will be made by the Bureau of Mines at its Reno, Nev., experiment station.

COPPER IN 1925

Production Approximately 4 Percent Higher Than 1924 And Largest Peace-Time Output

THE smelter production of copper from domestic ores in 1925 as determined by the Bureau of Mines, from reports of the smelters showing actual production for 11 months and estimated production for December, was 1,693,000,000 pounds, compared with 1,634,000,000 pounds in 1924. The 1925 production is the largest peace-time output being approximately 4 percent higher than that of 1924 which was heretofore the highest recorded with the exception of the war years, 1916, 1917, and 1918. The estimated smelter production from domestic ores for December, as reported by the smelters, was 137,000,000 pounds, somewhat lower than the average monthly rate for the year, or at the rate of 1,644,000,000 pounds a year. The estimated production for December, 1924 was exactly the same as that for December, 1925, 137,000,000 pounds. The production in December, 1924, however, was at a higher rate than during the preceding months.

The production of new refined copper from domestic sources, determined in the same manner as smelter production, was about 1,746,000,000 pounds, compared with 1,674,000,000 pounds in 1924. In 1925 the production of new refined copper from domestic and foreign sources amounted to about 2,237,000,000 pounds, compared with 2,260,000,000 pounds in 1924, a decrease of 23,000,000 pounds. The production of secondary copper by primary refineries, however, increased from 155,000,000 pounds to about 184,000,000 pounds in 1925, or 29,000,000 pounds, so that the total primary and secondary output of copper by the refineries was 6,000,000 pounds higher in 1925, being about 2,421,000,000 pounds compared with 2,415,000,000 pounds in 1924.

The imports of unmanufactured copper during the first 11 months of 1925, according to the Bureau of Foreign and Domestic Commerce, amounted to 594,489,150 pounds, a monthly rate of 54,000,000 pounds compared with 768,813,731 pounds for the entire year 1924, a monthly rate of 64,000,000 pounds. The imports in 1924 were the highest recorded.

The exports of copper during the first 11 months of 1925 amounted to 1,009,181,363 pounds compared with 1,116,915,484 pounds exported during the entire year 1924. The exports of 1917 are the highest ever recorded, those of 1924 are next, and those of 1925 will rank third. The figures of imports and exports in December will be available in the Bureau of Foreign and Domestic Commerce about January 20, 1926.

Stocks of refined copper at the end of 1925 were less than half those reported at the end of 1924, decreasing from 243,000,000 pounds at United States' refineries at the end of 1924 to estimated stocks of about 112,000,000 pounds at the end of 1925. Stocks of refined copper on November 30, 1925 were estimated at 119,000,000 pounds. Stocks of blister copper at the smelters, in transit to refineries, and at refineries, and materials in process of refining, were estimated to be about 398,600,000 pounds at the end of 1925 compared with 393,000,000 pounds on December 31, 1924. The smelters and refineries estimated that about 417,000,000 pounds were on hand November 30, 1925.

The quantity of refined copper withdrawn on domestic account during the year was about 1,485,000,000 pounds, compared with 1,355,000,000 pounds in 1924, an increase of 130,000,000 pounds. The method of calculation is shown below:

	1924	1925
Refinery production of new copper from domestic sources	1,674,000,000	1,746,000,000
Refinery production of new copper from foreign sources	586,000,000	491,000,000
Imports of refined copper (December estimated 1925)	146,000,000	120,000,000
Stocks of new refined copper January 1	264,000,000	243,000,000
	2,670,000,000	2,600,000,000
Exports of refined copper (ingots, bars, rods or other forms)	1,072,000,000	1,003,000,000
Stocks December 31	243,000,000	112,000,000
	1,315,000,000	1,115,000,000
Total withdrawn on domestic account	1,355,000,000	1,485,000,000

FUNDAMENTAL REACTIONS IN BLAST FURNACE

DURING the present fiscal year the Bureau of Mines will continue at its North Central Experiment Station at Minneapolis, its work of making a study of fundamental reactions taking place in the commercial iron blast-furnace.

The Bureau of Mines has completed a similar study on a Southern foundry furnace. For the purpose of extending the work and mainly for comparative purposes, the second phase of the work will be conducted on a Northern furnace, where Northern practice and conditions may be studied.

BENEFICIATION OF HIGH SILICA IRON ORES

THE purpose of an investigation being conducted at the Southern Experiment Station of the Bureau of Mines, Tuscaloosa, Ala., is to develop means of treating low-grade high-silica iron ores of the South, and particularly of the Birmingham district, whereby they may be rendered available for blast-furnace use. With the development of satisfactory methods of treatment will come a large increase in the iron-ore reserves. The purpose of the four studies is: (1) High-silica red ores, to remove part of the insolubles of the ore with a minimum loss of iron, thereby increasing the iron content in the product going to the blast furnace; (2) High-silica, specular gray hematite, similar to that for the high silica red ores; (3) Low-grade brown ores, to develop a coarse treatment for removal of clay, gravel, and chert; (4) Blast furnace flue dust, to remove enough carbon and insoluble material from the flue dust to make a concentrate high enough in iron for blast-furnace use. During the past fiscal year considerable work was done on the red and gray hematite. Tests have been completed on samples of ore from a number of localities in the red ore district of Alabama. Additional samples are being obtained for further tests. Good metallurgical results have been obtained on all samples of red and gray hematites tested. Work on the brown ores was started late in the year, with good results to date. In the study of gray-ores, work was completed on ores from part of the Talladega district, and begun on ores from other localities. The results of the flue dust investigation, which is practically completed, are irregular due to the many variables of the samples.

OPEN-HEARTH FURNACE REFRACTORIES

A STUDY of requirements for open-hearth furnace refractories is being continued by the Bureau of Mines. The purpose of the investigation is to determine the conditions to which refractories are subjected in open-hearth steel furnaces. During the past year accurate determinations were made by the temperatures existing in various parts of a basic furnace. Temperature gradients through wall and roof bricks were also determined. A large number of dust samples were taken from the furnace gases in an attempt to determine their source and composition and the nature of their attack upon refractories. This work is to be supplemented during the fiscal year 1925-26 by similar determinations on an acid furnace.

THE QUICKSILVER MINERALS

FROM the standpoint of the metallurgist, the only important quicksilver minerals are cinnabar and native quicksilver, state L. H. Duschak and C. N. Schuette, in Bulletin 222, recently issued by the Bureau of Mines. Pyrite and marcasite often are associated with the cinnabar, as are small quantities of other sulphides, including those of arsenic and antimony. Native sulphur and bituminous matter also occur in some ores.

Quicksilver ore is found in rocks of all geologic ages and all classes; hence the gangue material of the ore differs in different mines and often in the same mine. The common gangue rocks are limestone, calcareous shales, sandstone, serpentine, chert, andesite, basalt, and rhyolite. The great variety of gangue minerals means a corresponding variation in the physical characteristics of the ore. Two general types of cinnabar ore can be distinguished, namely: Disseminated ore, in which the cinnabar has impregnated a more or less fine-grained or highly brecciated gangue; and ores deposited in fissures and cracks of the country rocks. In at least one body of disseminated ore the cinnabar was precipitated simultaneously with the amorphous silica cementing a brecciated rock. The second type of ore merges into the first as the fissures and cracks become very minute; at its other extreme are large veins and bodies of almost pure cinnabar, sharply separated from the inclosing gangue.

Both types of ore may form high-grade or low-grade ore bodies, may be hard or soft, may break into coarse or fine fragments, may show the red cinnabar plainly or may not, and may contain any of the associated minerals already mentioned.

Metallurgical quicksilver ores may be classified with reference to their crushing behavior and their texture, as these physical characteristics affect the ease with which the vapors of mercury and mercuric sulphide are released. Important features of chemical composition are the amount of sulphur both free and combined, and the amount of bituminous material.

In general, the quicksilver ores of the United States do not carry other metallic compounds, such as those of arsenic and antimony, in sufficient quantity to influence their metallurgical treatment.

LEACHING COPPER ORES IN PLACE

ALL developments along the lines of the leaching of copper ores in place will be watched carefully by the southwest experiment station of the Bureau of Mines, at Tucson, Ariz. On account of the size of the ore blocks and the length of time needed for leaching, it is difficult to do experimental work. However, by compiling data on commercial leaching and observing the needs of the process, particularly the nature of solvents required, information that should be of value to the industry is being obtained. Data from many properties have been collected on this subject. The operations at the Ohio Copper mine are continuing successfully, but problems have arisen as to the best means of distributing the solutions. This will probably be done by means of an adit from which will be run drifts at right angles so as to put the solution equally over the whole ore body. Developments have shown that for other deposits where the rock weathers rapidly, or where an excessive amount of iron is precipitated, acidulated water is preferable. The development of the ferric sulphate-sulphuric acid process will fit in well with making a good solvent for leaching in place, together with the precipitation of the copper on sponge iron.

Approximately 75 samples of rare and non-metallic minerals, originating from 10 to 15 states, are received each month by the Rare and Precious Metals Station of the Bureau of Mines at Reno, Nev. These samples are examined by the technical staff of the station in an effort to assist prospectors in the identification of unusual minerals, of which the United States does not posses adequate supplies.

INDUSTRIAL DEVELOPMENT CONFERENCE

THE Southern Division of the American Mining Congress has called an Industrial Development Conference to meet at Memphis, Tenn., March 15, 16 and 17, 1926. Reservations already made indicate a great gathering of the leaders of the South, representing not only mineral resources but banking and transportation. The Conference marks the beginning of the accelerated movement for Southern industrial development.

The natural resources of the several Southern states justify an enormous onward movement. We call special attention to the announcement of this meeting on page 6 of this issue of the Mining Congress Journal.

The American Mining Congress offers its service to the South in the furtherance of this movement and the approaching conference is expected to produce some very definite plans for the upbuilding of industry in the great Mineral Empire fostering this meeting.

MODIFICATION OF ORSAT APPARATUS

A DESCRIPTION of the modification of the Orsat apparatus as used in the Bureau of Mines, for the analysis of gases is given in Technical Paper 320, just issued by the Bureau.

Many modifications of the original Orsat apparatus for gas analysis are in use at present, each having its merits and being particularly adapted for some special line of work, the Bureau points out. The number and the kind of pipettes used depend on the composition of the gas to be analyzed. If ethane is to be determined, in a complex gas mixture containing carbon monoxide, hydrogen, methane and ethane, a copper oxide tube is used for combustion of the hydrogen and carbon monoxide and the cuprous chloride pipettes may be omitted to advantage. If ethane is absent, as in producer and blast-furnace gases, two cuprous chloride pipettes may be used to absorb the carbon monoxide and the copper oxide tube may be omitted.

This paper describes the apparatus used in the Bureau of Mines gas laboratory at Pittsburgh, Pa., for the complete and partial analysis of gases. A complete analysis—including carbon dioxide, illuminants, oxygen, carbon monoxide, hydrogen, methane, and ethane—can be made without connecting or disconnecting any parts. Since all other constituents are removed before the paraffin hydrocarbons are burned, larger amounts of the paraffins may be often taken for combustion with oxygen, and more accurate determinations of methane and ethane can thus be obtained. The same argument holds true for hydrogen and carbon monoxide, which are determined by fractional combustion with copper oxide at 300°C. Either mercury or water may be used as the continuing liquid in the burette, depending on the accuracy desired.

As the Bureau of Mines has received many inquiries regarding gas-analysis methods used in its laboratories, this description of the Orsat apparatus is now uses is published in response to those inquiries.

Copies of Technical Paper 320, "The Bureau of Mines Orsat Apparatus for Gas Analysis," by A. C. Fieldner, G. W. Jones, and W. F. Holbrook, may be obtained from the Bureau of Mines, Washington, D. C.

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The White House—"At the other end of the avenue"—From the Capitol

LEGISLATIVE REVIEW

Tax And Railroad Legislation Occupy Important Position In Congress — Coal Proposals Dormant—Couzens Committee Makes Report—Numerous Bills Presented Which Directly Affect The Mining Industry Cover A Wide Range Of Subjects, Including Changes In Tariff Schedules

WHILE many important proposals are before Congress, chief interest centers in the revised tax bill and proposed legislation to create new machinery for the settlement of railroad labor disputes. The Senate Finance Committee has hurried the tax revision bill along its legislative course, and congressional leaders hope to see it passed about the middle of February. This will give time for adjustment of Senate amendments by the conference committee and final enactment of the bill before March 15, when income tax returns for 1925 are filed. The Senate Committee on Investigation of the Internal Revenue Bureau made its report, and its representatives appeared before the Finance Committee to urge changes in the tax law. The committee decided to separate mines and oil wells in the discovery depletion clause at the suggestion of Senator Shortridge, Republican, California, and to apply oil depletion on a percentage basis which will avoid the complicated problems of valuations. The changes are said to be fair to the mining industry and a happy solution of unfortunate circumstances incident to the investigation conducted by Senator Couzens, Republican, Michigan. The Senate committee also voted to add the capital stock tax to the corporation tax, which will avoid the necessity of two returns by corporations. The surtax rates were fixed at a maximum of 20 percent and in practically all respects the bill is regarded as a decided relief from burdensome taxation to the business of the country.

New machinery to settle railroad labor disputes is receiving the attention of Congress and is attracting favorable attention in the industrial world. This legislation is hailed as meaning the end of railroad strikes and may have an important bearing on other industrial disputes. Bills to carry out the proposal have the approval of 52 of the 72 leading railroads of the country and of the 20 principal organizations of railroad employes as represented by the railroad brotherhoods. Representatives of the railroads and the brotherhoods discussed the legislation with the President, who is understood to favor it. The only objection heard to the proposal has come from the National Association of Manufacturers, which says it does not go far enough by forbidding strikes. Under the proposed legislation the present Railroad Labor Board, created in 1920, would be superseded by a Federal Board of Mediation of five members, which would act in disputes only after failure to settle them by individual, regional, and national boards representing the railroads and employes.

Because of the continuance of the anthracite strike, numerous bills have been introduced looking toward its settlement. Congress has held off from acting in the

situation in the belief that the miners and operators would finally negotiate a new wage agreement and resume mining. Collapse of the negotiations early in January caused a renewal of bills on the subject. These suggested a special committee of Congress to negotiate a settlement, requesting the President to take steps to end the strike and authorizing the President to take over and operate mines during an emergency. As there are many Congressmen, including some of the leaders, who feel that the situation is one for Pennsylvania to handle, the disposition has been to wait until the present extra session of the legislature of the state, called to consider the strike situation, acts in the matter. Most of the bills on coal have been introduced by New York and Massachusetts members.

While the administration and congressional leaders have indicated their unwillingness to consider tariff revision at this session, a large number of bills proposing tariff changes have been introduced. The Democratic sponsors of tariff changes propose lower or no duties at all on many products, while Republican members have suggested new duties on products now admitted free. The Democratic suggestions cover calcium arsenate, iron and steel, aluminum and coal, while Republicans have proposed duties on copper, feldspar, and nitrate of soda.

Muscle Shoals is again before Congress. The House has passed a bill for consideration and report by a special committee of Congress on April 1 of proposals to lease the project for nitrates and power.

Proposals to apply the immigration restriction law to Canada, Mexico, and other South and Central American countries have been made.

Mine Bills

Mining bills introduced cover a wide range and include the following: Reduce areas or suspend leases on Indian lands in case of overproduction and low prices of oil; mining leases on Indian agency and school lands; extend the time to drill under oil permits; investigate potash resources; sulphur prospecting permits and leases; suspend annual assessment requirement on carnotite mining claims; and establishing mine rescue stations at Madisonville and Pineville, Ky.

The Denison Blue Sky Bill, which would regulate the sale of mining securities was advanced a legislative stage by being reported to the House by the Interstate Commerce Committee. It is now subject to consideration by the House.

Bills to abolish the Federal Trade Commission and Tariff Commission were proposed. Repeal of the flexible provision of the tariff law, under which duties may be lowered or raised 50 percent, was also suggested.

Congress hardly finishes one or a group of investigations before it launches into others. As the Internal Revenue Bureau inquiry was coming to an end, the Senate began on investigation by its Judiciary Committee of the alleged failure of the Department of Justice to prosecute the Aluminum Company of America, and the House Interstate Commerce Committee undertook an inquiry as to foreign monopolies in tin, nitrate, potash, quicksilver, and other raw materials. Other investigations proposed are as to the operations of the Tariff Commission and its inquiries under the flexible provision of the tariff law; of metal corporations; and of alleged monopolies in steel, aluminum, copper, brass, oil, coal, chemicals, etc.

The following is a summary of mining bills recently introduced:

Blue Sky

H. R. 52. Introduced by Mr. Denison (Rep., Ill.). Reported by the Committee on Interstate Commerce. This is the so-called Blue Sky Bill and provides for Federal regulation of the issuance of mining and other securities.

H. J. Res. 95. Introduced by Mr. Brumm (Rep., Pa.). Referred to the Committee on Mines and Mining. This bill suspends for three years, from July 1, 1925, the performance of annual assessment work on carnotite or other radium bearing ore mining claims.

S. 1923. Introduced by Mr. King (Dem., Utah). Referred to the Committee on Public Lands. This bill provides for the sale in 40-acre tracts of land in the former Uncompahgre Indian Reservation in Utah containing gilsonite, asphaltum, elaterite, or other like substances.

H. R. 7581. Introduced by Mr. Leavitt (Rep., Mont.). Referred to the Committee on Indian Affairs. This bill proposes to authorize the Interior Department to reduce lease areas or suspend the issuance of leases for two years on the Osage Indian Reservation in Oklahoma when overproduction of oil or inadequate oil prices makes it desirable.

H. R. 7752. Introduced by Mr. Leavitt (Rep., Mont.). Referred to Indian Committee. This bill authorizes mining leases on lands reserved for Indian agency and school purposes.

Mine Rescue

H. R. 3879. Introduced by Mr. Kincheloe (Dem., Ky.). Referred to the Committee on Mines and Mining. This bill authorizes the establishment of a mine rescue station at Madisonville, Ky.

H. R. 5953. Introduced by Mr. Robsion (Rep., Ky.). Referred to the Committee on Mines and Mining. This bill authorizes the establishment of a mine rescue station at Pineville, Ky.

H. R. 6574. Introduced by Mr. Sutherland (Rep., Alaska). Referred to the Committee on Public Lands. This bill extends the mining laws of Alaska, covering location, holding, entry, or lease of mineral lands or deposits, to lands or deposits on Annette Island, Alaska. The bill authorizes the Interior Department to lay a tax of not more than 1 percent on the net income of any operating mine on that island for the benefit of the people of Metlakatla.

H. R. 208. Introduced by Mr. Morrow (Dem., N. Mex.). Referred to the Committee on Public Lands. This bill authorizes the exchange by railroads of their land grants for land which is nonmineral in character, except as to coal, so as to place private and Government lands in compact holdings.

H. R. 7183. Introduced by Delegate Davila, of Porto Rico. Referred to the Insular Committee. It provides a form of government for the Virgin Islands and stipulates that mines or minerals under the surface of private lands in the islands shall be placed under the government of the islands and administered for their benefit.

Potash Research

S. 1821. Introduced by Mr. Sheppard (Dem., Tex.). Referred to the Committee on Agriculture. This bill appropriates $555,000 for each of the next five years for investigations by the Geological Survey and Department of Agriculture to determine the location and extent of potash deposits and of improved methods of recovering potash.

S. 1829. Introduced by Mr. Ransdell (Dem., La.). Referred to the Committee on Public Lands. This bill authorizes the Interior Department to issue two-year prospecting permits for 640 acres of sulphur lands, except in San Bernardino County, Calif. If the permittee discovers sulphur, he could lease the land at a royalty of 5 percent of the quantity or gross value of the sulphur. Persons holding oil and gas permits who discover sulphur in their lands will also be entitled to leases. Lands known to contain sulphur shall be sold at public auction at an advance rental of 50 cents per acre per year. Permits or leases for sulphur lands may be issued for deposits of sulphur in lands containing coal or other minerals on condition that deposits other than sulphur shall be reserved to the United States and be disposed of under proper laws. This bill makes the sulphur leases and permits subject to the leasing law.

Raw Materials

H. Res. 59. Introduced by Mr. Tilson (Rep., Conn.). Passed by the House. Under this resolution the House Committee on Interstate Commerce is investigating foreign control of production and exportation of tin, rubber, nitrates, potash, quicksilver, and other important raw materials and their effects upon the

IMPORTANT BILLS REVIEWED IN THIS ISSUE

MINING—
H. R. 52: Denison (R.), Ill. Blue Sky.
H. J. Res. 95: Brumm (R.), Pa. Assessment Suspension.
H. R. 7752: Leavitt (R.), Mont. Indian Leases.
H. R. 3879: Kincheloe (D.), Ky. Mine Rescue Station.
H. R. 5953: Robsion (R.), Ky. Mine Rescue Station.
S. 1821: Sheppard (D.), Tex. Potash Research.
S. 1829: Ransdell (D.), La. Sulphur Leases.
H. Res. 59: Tilson (R.), Conn. Raw Materials Inquiry.
H. R. 6542: Sutherland (R.), Alaska. Mining Claims.

COAL—
H. R. 7371: Sinnott (R.), Oreg. Coal Land Trespass.
H. R. 327: Rogers (R.), Mass. Coal Embargo.
H. R. 5694: Frothingham (R.), Mass. Mine Control.
H. Res. 45: Jacobstein (D.), N. Y. Strike Mediation.
H. Res. 47: Bloom (D.), N. Y. Strike Settlement.
H. R. 7671: Bloom (D.), N. Y. Emergency Control.
H. J. Res. 51: Griffin (D.), N. Y. Mine Control.
S. Res. 115: Copeland (D.), N. Y. Strike Mediation.
H. Con. Res. 5: Somers (D.), N. Y. Strike Inquiry.
H. R. 3980: Treadway (R.), Mass. Government Operation.
S. Res. 99: La Follette (R.), Wis. Anthracite Finances.
H. R. 310: Luce (R.), Mass. Quality Standards.
H. R. 3979: Treadway (R.), Mass. Anthracite Bureau.

TARIFF—
S. 2018: Cameron (R.), Ariz. Copper Duty.
H. R. 7668: Williamson (R.), S. Dak. Feldspar Duty.
H. R. 7586: Reid (R.), Ill. Nitrate of Soda Duty.
H. R. 7101: Barkley (D.), Ky. Iron and Steel Duty.
H. R. 6116: Oldfield (D.), Ark. Coal Duty.
H. R. 7184: Hull (D.), Tenn. Coal, Calcium, and Cyanamid.
H. R. 3984: Vinson (D.), Ga. Calcium Arsenate.
H. R. 6975: Barkley (D.), Ky. Free Aluminum.
S. 666: King (D.), Utah. Abolish Tariff Commission.
S. 544: Jones (D.), N. Mex. Tariff Inquiry.
S. Res. 103: Smoot (R.), Utah. Tariff Commission Investigation.
H. Res. 71: Oldfield (D.), Ark. Aluminum Inquiry.

IMMIGRATION—
H. R. 6741: Box (D.), Tex. Mexican Immigration.
H. R. 3875: Kelly (R.), Pa. Immigration Inquiry.

TRANSPORTATION—
H. R. 7180: Parker (R.), N. Y. Railroad Labor.
S. 2: Howell (R.), Nebr. Rate Reduction.
S. 1870: Cummins (R.), Iowa. Consolidations of Railroads.

commerce of the United States, both as to supply and price.

S. 1799. Introduced by Mr. Capper (Rep., Kans.). Referred to the Committee on Commerce. This bill would authorize cooperative purchasing and importation into the United States by Americans of raw commodities which are produced principally in foreign countries. The bill provides that the antitrust act shall not be construed as declaring illegal an association which engages solely in the purchase of raw commodities in foreign countries for importation, sale, and distribution in the United States, nor shall that law declare illegal any agreement made or act done in the course of such purchase, importation, sale, or distribution by such association, where such commodities are produced principally in foreign countries and where the people of the United States are dependent on their production in foreign countries, and where their production, sale, or distribution is found by the Department of Commerce to be controlled by any foreign government, combination, or monopoly. Associations operating under this law would file certificates with the Federal Trade Commission. Provision is made that these associations shall not otherwise restrain trade, shall receive as members all persons or corporations in the United States who desire to join, and shall not discriminate against manufacturers or users of imported raw commodities.

S. 2461. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Public Lands. This bill extends for two years the time in which holders of oil and gas permits may begin drilling operations in cases where for various causes they have not been able to conduct such operations.

S. 458. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Irrigation. This bill, which provides for development of lands in the Colorado River Indian Reservation, authorizes their classification as to mineral content and appraisal at not less than $10 per acre. The mineral land is to be opened to entry under the general mining laws and to be paid for in five annual installments. Receipts from the sale of the mineral and other lands will be used for irrigation development.

Alaskan Mines

H. R. 6542. Introduced by Mr. Sutherland (Rep., Alaska). Referred to the Committee on Public Lands. This bill authorizes the Interior Department to permit the use of timber on public lands in Alaska by miners and prospectors for minerals and others for mining, prospecting, and other uses.

H. R. 6572. Introduced by Mr. Sutherland (Rep., Alaska). Referred to the Committee on Mines and Mining. This bill amends the mining laws of Alaska to read as follows:

"That no person shall hereafter locate any placer-mining claim in Alaska as attorney for another unless he is duly authorized thereto by a power of attorney in writing, duly acknowledged and recorded in any recorder's office in the judicial division where the location is made. Any person so authorized may locate placer-mining claims for not more than two individuals or one association under such power of attorney, but no such agent or attorney shall be authorized or permitted to locate more than two placer-mining claims for any one principal or association in any one recording district during any calendar month, and no placer-mining claim shall hereafter be located in Alaska except under the limitations of this act.

"That no person shall hereafter locate, cause or procure to be located for himself more than two placer-mining claims within any one recording district in any calendar month. One or both of such locations may be included in an association claim."

S. 2339. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Committee on Public Lands. This bill amends

section 27 of the leasing law by allowing permits or leases for 2,560 acres in a state for coal, phosphate, or sodium; 7,680 acres in a state for oil and gas; and 2,560 acres in a geologic structure of the same producing field.

H. R. 7372. Introduced by Mr. Sinnott (Rep., Oreg.) Referred to the Committee on Public Lands. This is similar to the foregoing. The legislation was recommended by the Interior Department.

S. Res. 113. Introduced by Mr. Frazier (Rep., N. Dak.). This resolution directs the Tariff Commission to investigate costs of production, capitalization, efficiency, business methods, and profits or losses of typical corporations manufacturing metal and metal products, including an equal number showing large profits and those claiming no net income in 1923. The commission would report May 31. The resolution says the Internal Revenue Bureau reports that in 1923, after deducting alleged deficits of corporations claiming no net income, the net income of corporations manufacturing metals and metal products was $1,249,415,313. The resolution says no investigation of cost of production, etc., of many of these corporations has been made for many years.

Metal Inquiry

S. Res. 112. Introduced by Mr. King (Dem., Utah). This resolution directs the Senate Judiciary Committee to investigate the extent to which the importation, production, and distribution of potash, nitrates, steel, aluminum, copper, brass, petroleum, coal, chemicals, dyes, etc., are being controlled by foreign or domestic monopolies or monopolistic trade associations; why they are not being tried for violation of the antitrust act; and to recommend legislation to prevent such monopolies. The resolution says it is claimed that foreign monopolies control supplies of potash and nitrates imported into the United States and that monopolistic trade associations have been formed in the United States to control domestic production and distribution and to fix prices in the domestic markets for these products. The resolution says the Government is not enforcing the antitrust act against these combinations.

Coal Lands

H. R. 7371. Introduced by Mr. Sinnott (Rep., Oreg.). Referred to the Committee on Public Lands. This bill, introduced at the suggestion of the Interior Department, would make it unlawful to mine and remove coal of any character, whether anthracite, bituminous, or lignite, from beds or deposits in lands of the United States, or in deposits or beds reserved to the United States, with the intent to appropriate, sell, or dispose of the same. Persons who violate the act shall be deemed guilty of misdemeanor, and fined not more than $1,000 or imprisoned not more than one year, or both. Nothing in this act, however, shall interfere with any right or privilege conferred by existing laws of the United States.

S. 2311. Introduced by Mr. Stanfield (Rep., Oreg.) Referred to the Committee on Public Lands. This is similar to the foregoing.

Coal Embargo

H. R. 327. Introduced by Mrs. Rogers (Rep., Mass.) Referred to the Committee on Interstate Commerce. This bill authorizes the President to declare an embargo, partial or complete, on the exportation of anthracite or bituminous, or both.

Mine Control

H. R. 5694. Introduced by Mr. Frothingham (Rep., Mass.). Referred to the Committee on Interstate Commerce. This bill is similar to the foregoing, and also authorizes the President "to take over and run the mines" in a national emergency.

H. Res. 45. Introduced by Mr. Jacobstein (Dem., N. Y.). Referred to the Rules Committee. This resolution requests the President to offer his services as mediator to end the anthracite strike. It also directs the Labor and Commerce Committees of the House to jointly consider legislation to authorize the President to take over and operate anthracite mines, reporting in 30 days.

H. Res. 47. Introduced by Mr. Bloom (Dem., N. Y.). Referred to the Committee on Interstate Commerce. This resolution proposes to express the "sense of the House that the President should urge anthracite operators and miners to renew their negotiations for a new wage scale, and that the Government lend assistance to compose their differences and to bring about a resumption of mining."

H. R. 7671. Introduced by Mr. Bloom (Dem., N. Y.). Referred to the Committee on Interstate Commerce. This bill authorizes the President to take control of and transport necessities of life during a national emergency. It provides:

"That when an emergency exists in the production of or transportation of any necessity of life through the suspension of or lessening of operation of the means of production of or transportation of any necessity of life for a period of at least 30 days, so that the normal supply of the necessities of life and transportation thereof are suspended or lessened and the free and normal operation of industry are impaired, the President, in order to safeguard the public health and protect and promote the public welfare, is authorized to take temporary control of any or all means of production or of transportation of any necessity of life and proceed with the production and transportation thereof until the emergency shall have passed."

H. J. Res. 51. Introduced by Mr. Griffin (Dem., N. Y.). Referred to the Committee on Interstate Commerce. This bill provides that when an emergency exists in the mining and transportation of coal, through suspension of operation in the mines, the President shall be authorized to take temporary control of any or all mines in the localities affected and proceed with the mining and distribution of coal until the emergency has passed.

H. R. 7560. Introduced by Mr. Boylan (Dem., N. Y.). Referred to the Committee on Interstate Commerce. This is similar to the foregoing.

S. Res. 115. Introduced by Mr. Copeland (Dem., N. Y.). This resolution requests the "President to take whatever steps are necessary and proper to bring about an immediate resumption of anthracite mining." The resolution says that as a result of the nonoperation of the mines the bins of dealers and consumers are empty and the conference between operators and miners to settle the strike has ended in failure. The resolution says substitutes for anthracite are unsatisfactory and unduly expensive.

H. Con. Res. 5. Introduced by Mr. Somers (Dem., N. Y.). Referred to the Committee on Rules. This resolution proposes appointment by the President of a congressional committee to settle the anthracite strike. It would be known as the joint committee on the mediation of the coal strike and would consist of three Senators and three Members of the House. The committee would call a conference of anthracite operators and miners or their representatives for the purpose of mediating their differences. The committee would conduct negotiations for settlement of the anthracite strike in order to secure a continuous supply of coal at a price that is reasonable, and would report its findings, recommendations, and appropriate legislation not later than February 15, 1926.

H. R. 3980. Introduced by Mr. Treadway (Rep., Mass.). Referred to the Committee on Interstate Commerce. It provides that in a national emergency caused by stoppage of coal production the President may take over the plant and business of those engaged in the production of coal. The President would fix the compensation to be paid the owners of such property. Owners not satisfied with their payments could sue in the Court of Claims. The bill also authorizes the President to fix wholesale and retail coal prices. Persons violating the law would be subject to a fine of $500, or 25 percent of the value of the coal involved in the transaction.

Anthracite Finances

S. Res. 99. Introduced by Mr. La Follette (Rep., Wis.). Adopted by the Senate. The resolution calls on the Treasury Department for a statement based on corporation income tax returns for 1924,

showing for each corporation engaged in the mining of anthracite, the amount of capital stock, invested capital, net income, amount charged to depletion and depreciation and amount of Federal tax paid.

Quality Standards

H. R. 310. Introduced by Mr. Luce (Rep., Mass.) Referred to the Committee on Interstate Commerce. This measure proposes to regulate the quality of domestic anthracite. It stipulates that coal of domestic sizes shall not contain greater percentages of ash than are prescribed in the bill. Anthracite mining companies may file with the Bureau of Mines a statement of standard of quality they are prepared to maintain, and shall state their compliance with the law on bills of lading. The bureau would examine domestic anthracite offered for sale to determine if the standards of quality are maintained. Violation of the act would incur a penalty of $200 for the first offense and $300 for subsequent offenses or imprisonment for one year, or both.

Coal Bureau

H. R. 3979. Introduced by Mr. Treadway (Rep., Mass.). Referred to the Committee on Interstate Commerce. This bill proposes to establish an anthracite coal bureau in the Interstate Commerce Commission to regulate the anthracite industry. The bill declares that commerce in anthracite is affected by a national public interest. Every dealer would be required to register with the bureau. Registration certificates may be refused, revoked, or suspended in case of violation of this act. The Director of the Bureau, who would receive a $7,000 yearly salary, but who could not be selected from those engaged in producing, dealing, or owning an interest in fuel, would establish on July 1 yearly the proportion of anthracite which may be shipped to each state during the year beginning the next January. He could establish standards of size, quality, and condition of anthracite. He would collect and report to Congress data on anthracite, including costs of mining, selling, and shipping. The director is authorized to require annual reports from dealers and operators of anthracite mines.

Coinage

S. 2282. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Banking Committee. This bill proposes the coinage of 50-cent silver pieces in memory of the late President Harding.

H. R. 6247. Introduced by Mr. Sinnott (Rep., Oreg.). Referred to the Committee on Coinage. This is similar to the foregoing.

H. R. 7582. Introduced by Mr. Arentz (Rep., Nev.). Referred to the Coinage Committee. This bill proposes to coin not more than a million 50-cent pieces in commemoration of the completion of the Lincoln and Victory Highways, and the Nevada Transcontinental Highways Exposition in Reno next year.

S. 575. Introduced by Mr. Pittman (Dem., Nev.). Referred to the Committee on Banking. This is similar to the foregoing.

H. R. 124. Introduced by Mr. Burtness (Rep., N. Dak.). Referred to the Committee on Banking. This bill proposes to change the value of the gold dollar from its present fixed standard to one based on its buying power. The so-called "commodity dollar" would be fixed on commodity prices determined by a monetary standard division in the Treasury Department.

H. R. 311. Introduced by Mr. MacGregor (Rep., N. Y.). Referred to the Committee on Coinage. This bill proposes to establish the gold and silver currency on a basis of interchangeable value throughout the world.

H. R. 402. Introduced by Mr. Goldsborough (Dem., Md.). Referred to the Committee on Banking. This bill proposes to stabilize the purchasing power of money by fixing its value on the basis of commodity prices.

H. R. 5389. Introduced by Mr. Colton (Rep., Utah), by request. Referred to the Committee on Banking. The bill proposes to coin twenty-cent, and two-cent pieces.

H. J. Res. 46. Introduced by Mr. Le Guardia (Rep., N. Y.). Referred to the Committee on Foreign Affairs. This resolution authorizes the President to invite foreign governments to a conference for the purpose of establishing a permanent money-exchange commission to determine the exchange value of gold and other currency.

S. 779. Introduced by Mr. Smoot (Rep., Utah). Referred to the Committee on Finance. This bill proposes to appropriate $25,000 until July 1, 1927 for the purpose of paying transportation and insurance charges on silver dollars from the Treasury and mints to federal reserve banks and by them to applicants.

Tariff Measures

S. 2018. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Finance. This bill proposes to place a duty of six cents per pound on imported copper.

H. R. 7668. Introduced by Mr. Williamson (Rep., S. Dak.). Referred to the Committee on Ways and Means. This bill proposes a duty of $3 per ton on imported crude feldspar.

H. R. 7586. Introduced by Mr. Reid (Rep., Ill.). Referred to the Committee on Ways and Means. This bill proposes a duty of 35 percent ad valorem on nitrate of soda, other than that manufactured from nitrogen of the air and not intended to compete with double refined nitrate of soda in the United States or soda as mined and singly refined and sold as 95 percent or 96 percent pure, which latter products would be admitted free.

H. R. 7101. Introduced by Mr. Barkley (Dem., Ky.). Referred to the Committee on Ways and Means. This bill would restore the 1913 tariff act duties on iron and steel.

H. R. 6116. Introduced by Mr. Oldfield (Dem., Ark.). Referred to the Committee on Ways and Means. This bill proposes to repeal the provision in the tariff law authorizing a duty on coal in cases where foreign countries impose a duty on American coal.

H. R. 7184. Introduced by Mr. Hull (Dem., Tenn.). Referred to the Ways and Means Committee. This bill proposes to repeal sections of the tariff law authorizing a duty on imported coal; calcium; cyanamid, and gunpowder and other explosives, in cases where foreign countries impose duties on receipts of these commodities from the United States.

H. R. 3984. Introduced by Mr. Vinson (Dem., Ga.). Referred to the Committee on Ways and Means. This bill proposes to transfer calcium arsenate from the dutiable to the free list in the tariff law. It is provided that if foreign countries impose a duty on this product when received from the United States a like duty shall be levied on such imports in the United States from such countries.

H. R. 6975. Introduced by Mr. Barkley (Dem., Ky.). Referred to the Committee on Ways and Means. This bill proposes to place aluminum and its alloys and products on the free list.

H. R. 175. Introduced by Mr. Knutson (Rep., Minn.) Referred to the Committee on Ways and Means. This measure proposes a duty of one hundred percent ad valorem on granite.

H. R. 56. Introduced by Mr. Fairchild (Rep., N. Y.). Referred to the Committee on Ways and Means. This bill would impose an extra duty of 5 percent on goods imported in other than American vessels.

Tariff Commission

S. 666. Introduced by Mr. King (Dem., Utah). Referred to the Committee on Finance. This bill proposes to abolish the Tariff Commission.

S. 665. Introduced by Mr. King (Dem., Utah). Referred to the Committee on Finance. This bill proposes to repeal the flexible provision of the tariff act which authorizes the raising or lowering of duties by 50 percent.

H. R. 6230. Introduced by Mr. Hull (Dem., Tenn.). Referred to the Committee on Ways and Means. This bill is similar to the foregoing.

H. R. 3783. Introduced by Mr. Andrew,

(Rep., Mass.). Referred to the Committee on Ways and Means. This bill proposes to amend the flexible provision of the tariff law by authorizing a duty of not more than 25 percent on articles now on the free list in case investigation shows that the cost of production is lower in foreign countries than in the United States. At present there is no authority to place a duty under the provision on articles admitted free of duty.

S. 544. Introduced by Mr. Jones (Dem., N. Mex.). Referred to the Committee on Finance. This proposes to authorize the Tariff Commission to investigate the industrial effects of the customs laws; relations between duties on raw materials and finished products; imposition or exemption of customs duties; and various factors affecting the import and export trade. It authorizes an appropriation of $1,000,000 per year.

S. Res. 103. Introduced by Mr. Smoot (Rep., Utah). This resolution directs the Finance Committee to investigate the operation of the flexible provision of the tariff act and the functions and activities of the Tariff Commission.

S. Res. 102. Introduced by Mr. King (Dem., Utah). This is similar to the foregoing.

Aluminum Inquiry

H. Res. 71. Introduced by Mr. Oldfield (Dem., Ark.). Referred to the Committee on Rules. This resolution authorizes the Ways and Means Committee to investigate the aluminum tariff. It would cover cost of production, earnings, and distribution between owners and workers in the industry; condition of the industry in the United States regarding the number of companies producing aluminum, and competitive conditions; the result of the "exorbitant" tariff on aluminum; whether the Aluminum Company of America is a monopoly, and whether the tariff has aided it in establishing such monopoly; effect of the tariff on aluminum manufacturers and prices and on the automobile industry; and the refusal of the Federal Trade Commission to give the Department of Justice data regarding the Aluminum Company. The committee would report in two months.

H. Res. 74. Introduced by Mr. Frear (Rep., Wis.). Referred to the Rules Committee. This proposes an investigation of the control and production of aluminum in the United States, covering prices, secret agreements, profits and whether the tariff acts as an embargo against imports.

H. Res. 75. Introduced by Mr. Frear (Rep., Wis.). Referred to the Rules Committee. This provides for a similar investigation of chemicals and dyes.

Immigration Restriction

H. R. 6741. Introduced by Mr. Box (Dem., Tex.). Referred to the Committee on Immigration. This bill proposes to apply the 2 percent quota restriction law to immigrants from Mexico, Cuba, Canada and other countries of Continental America and adjacent islands.

H. R. 7559. Introduced by Mr. Bacon (Rep., N. Y.). Referred to the Committee on Immigration. This bill is similar to the foregoing.

H. R. 3875. Introduced by Mr. Kelly (Rep., Pa.). Referred to the Committee on Immigration. This bill proposes to establish a commission of eight members appointed by the President and one each by the Secretaries of State, Treasury, Commerce and Labor to investigate and report within three years on an immigration policy.

H. Res. 35. Introduced by Mr. Leavitt (Rep., Mont.). Referred to the Committee on Rules. It provides for an investigation and report not later than February, 1927, by the House Labor Committee as to a national system for distribution of labor through expansion of the United States Employment Service or otherwise, to meet problems growing out of the restriction of immigration, such as a possible labor shortage.

H. R. 102. Introduced by Mr. Aswell (Dem., La.). Referred to the Committee on Immigration. This bill provides for the yearly registration of aliens, under supervision of the Department of Labor, at fees of $10 for the first year and $5 for subsequent years for aliens over 21 years old, and $3 for aliens between 16 and 21. The bills appropriates $500,000.

H. R. 5583. Introduced by Mr. Aswell (Dem., La.). Referred to the Committee on Immigration. This is similar to the foregoing.

H. R. 344. Introduced by Mr. Johnson (Rep., Wash.). Referred to the Committee on Immigration. This bill supplements the naturalization laws and provides for the deportation of undesirable aliens.

Railroad Labor

H. R. 7180. Introduced by Mr. Parker (Rep., N. Y.). Referred to the Committee on Interstate Commerce. This bill proposes a new system of adjusting railroad labor disputes. It abolishes the Railroad Labor Board and substitutes individual, regional and national boards and a Federal Board of Mediation of five members. This bill has the approval of railroads and the railroad brotherhoods representing the workers who have discussed it with the President. It appropriates $300,000.

S. 2306. Introduced by Mr. Watson (Rep., Ind.). Referred to the Interstate Commerce Committee. This is similar to the foregoing. The committee has given hearings on the measure.

H. R. 5370. Introduced by Mr. Madden (Rep., Ill.). Referred to the Committee on Interstate Commerce. This bill provides that contracts restricting, limiting or interfering with the rights of railroads to employ any person in any capacity shall be "interferences in interstate commerce and void." The bill also provides that rules and working conditions of railroad employes shall be the same for all employes of each class and craft, whether they are members of organizations or not.

Rail Rates

S. 2. Introduced by Mr. Howell (Rep., Nebr.). Referred to the Committee on Interstate Commerce. This measure proposes to "re-establish competition in railroad rates as in effect prior to the present increased rates," by limiting the powers of the Interstate Commerce Commission to establish maximum rates only.

H. R. 4529. Introduced by Mr. Shallenberger (Dem., Nebr.). Referred to the Committee on Interstate Commerce. This bill repeals section 15a of the commerce act which guarantees railroads earnings of 5½ percent and restores the railroad rates which were in effect prior to the increase made in August, 1920.

S. 751. Introduced by Mr. Mayfield (Dem., Tex.). Referred to the Committee on Interstate Commerce. This bill is similar to the foregoing.

H. R. 6362. Introduced by Mr. Newton (Rep., Minn.). Referred to the Committee on Interstate Commerce. This bill authorizes railroads to earn a "fair return" on the value of their property.

H. R. 5393. Introduced by Mr. Colton (Rep., Utah), by request. Referred to the Committee on Interstate Commerce. This bill establishes uniform base, car and class rates for freight shipments on the basis of a rate of one cent per ton mile.

Steel Cars

H. R. 4475. Introduced by Mr. Kelly (Rep., Pa.). Referred to the Committee on Postoffices. This bill provides that steel cars shall be used in the railway postal service.

H. R. 333. Introduced by Mr. Denison (Rep., Ill.). Referred to the Committee on Interstate Commerce. This bill provides that after July 1, 1926, railroads shall use baggage and express cars made of steel.

S. 951. Introduced by Mr. Harris (Dem., Ga.). Referred to the Committee on Interstate Commerce. This bill makes it unlawful for railroads to use other than steel or steel underframe cars between cars of such type in the passenger service after thirty days from passage of this measure.

S. 1142. Introduced by Mr. Robinson (Dem. Ark.). Referred to the Committee on Interstate Commerce. This measure provides that after July 1, 1927 railroads shall use steel express and baggage cars.

Rail Consolidations

S. 1870. Introduced by Mr. Cummins (Rep. Iowa). Referred to the Committee on Interstate Commerce. This bill provides for consolidation of railroads and unification of railway properties.

H. R. 5394. Introduced by Mr. Colton (Rep. Utah), by request. Referred to the Committee on Interstate Commerce. This bill proposes consolidation of railroads into two or more systems entering Chicago, Boston, New York, Philadelphia, Baltimore, Norfolk, Charleston, Jacksonville, New Orleans, Galveston, Los Angeles or San Francisco, Portland, Ore., and Seattle, Wash.

Regional Commissions

H. R. 74. Introduced by Mr. Hawes (Dem. Mo.). Referred to the Committee on Interstate Commerce. This bill authorizes the creation of regional Interstate Commerce Commissions, each commission to consist of one commissioner from each of the states included in the district.

H. R. 75. Introduced by Mr. Hawes (Dem. Mo.). Referred to the Committee on Interstate Commerce. This bill establishes seven regional branches of the Interstate Commerce Commission with headquarters at Boston, New York, Atlanta, Cleveland, Chicago, St. Louis, and San Francisco.

S. 1547. Introduced by Mr. Smith (Dem. S. C.). Referred to the Committee on Interstate Commerce. This bill proposes to reorganize the Interstate Commerce Commission by providing for twelve commissioners at $12,000 annual salary for seven-year terms. The bill provides that in appointing the commissioners there shall be three representatives each from four divisions of the country—northeastern, southeastern, northwestern and southwestern.

H. R. 7092. Introduced by Mr. Garber (Rep., Okla.). Referred to the Committee on Interstate Commerce. This bill reduces the Interstate Commerce Commission to seven members and creates five regional commerce comsions of five members each with headquarters at Atlanta, Minneapolis, Oklahoma City, Spokane and Los Angeles.

H. R. 7483. Introduced by Mr. Rayburn (Dem., Tex.). Referred to the Committee on Interstate Commerce. This bill provides that each of the twelve Interstate Commerce Commissioners shall be appointed from twelve separate districts into which the bill divides the country for this purpose.

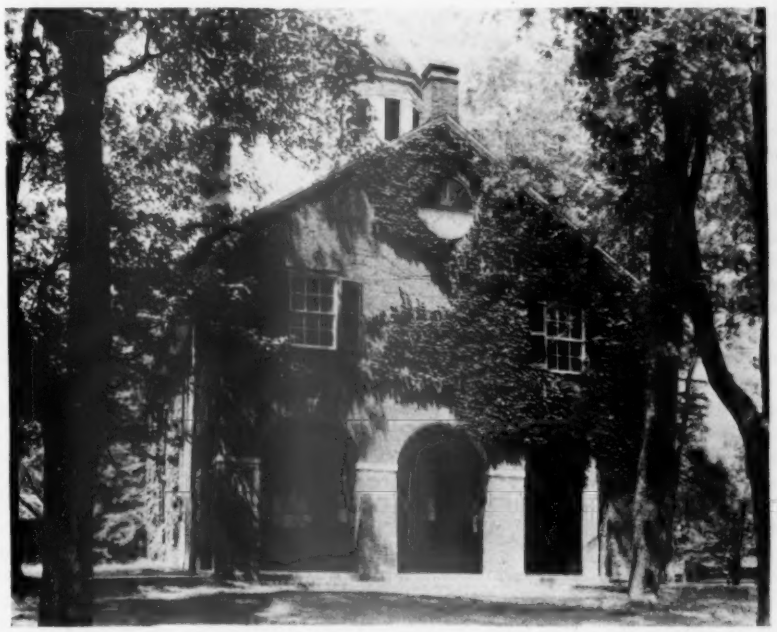
Rail Extensions

S. 759. Introduced by Mr. Pittman (Dem., Nev.) Referred to the Committee on Interstate Commerce. This bill would require railroads to secure permission from the Interstate Commerce Commission to build new lines or abandon any of their lines.

H. R. 5367. Introduced by Mr. Hudson (Rep. Mich.). Referred to the Committee on Interstate Commerce. This bill provides that railroads need not secure permission from the Interstate Commerce Commission to build a new line or extend a line within a State.

S. 750. Introduced by Mr. Mayfield (Dem, Tex.). Referred to the Committee on Interstate Commerce. This bill provides that railroads need not obtain permission from the Interstate Commerce Commission to construct new lines or extensions of railroads where the new line or extension is in one State. Railroads desiring to abandon their lines wholly within a State must get permission to do so from the State as well as from the Interstate Commerce Commission.

H. R. 7191. Introduced by Mr. Sanders (Dem., Tex.). Referred to the Committee on Interstate Commerce. This bill gives the States power to regulate intrastate commerce.



Fairfax County Court House, Virginia. In this historic old building, not far from the District of Columbia, the will of President Washington is filed

MEETING OF FEDERAL OIL CONSERVATION BOARD CALLED

THE Secretary of the Interior, Hon. Hubert Work, as Chairman of the Federal Oil Conservation Board, has designated February 10 and 11 as dates on which public hearings will be held by the Board to enable representatives of the oil industry to be present and express their views relative to national petroleum conditions.

Secretary Work said the two days will be devoted to hearing the industry's representatives, and those desiring to submit lengthy arguments, statistical and other data, will be invited to render such extended views in writing within 10 days immediately following the public hearings. After the formal hearings have been completed, an opportunity will be given for limited discussion outside of the arranged program.

It is the desire of the Board, the Chairman said, to hear from all schools of thought in the industry. It is expected that the following may be present to give their views: Amos L. Beaty, President, The Texas Company; W. N. Davis, President, Mid-Continent Oil and Gas Association; George S. Davison, President, Gulf Refining Company; Henry L. Doherty; C. F. Kettering, President, General Motors Research Corporation; K. R. Kingsbury, President, Standard Oil Company of California; J. O. Lewis, Consulting Petroleum Engineer; L. V. Nicholas, President, National Petroleum Marketers Association; Thomas A. O'Donnell, Associated Oil Company; J. Edgar Pew, President, American Petroleum Institute; Mark L. Requa; John D. Rockefeller, Jr.; W. C. Teagle, Standard Oil Company of New Jersey; Prof. Lester C. Uren, University of California.

Others who may wish to appear at the public hearings are *invited to communicate immediately with the Chairman*, stating the topic it is desired to discuss, in order that the Board's program may be formulated with some degree of continuity and the subjects grouped for the guidance of the Board and those attending the hearings.

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Metal Mining Industry

HYDROMETALLURGY AT THE ADVENT OF 1926

A Critical Review Of The Progress Of Hydrometallurgy, Outlining Various Processes Used In Gold, Silver, Copper, Lead And Zinc Industries, And Containing Many Suggestions For Improving Results So Far Obtained

By STUART CROASDALE, Ph. D.*

PROGRESS in an art, like progress in civilization, is reviewed better from the panorama of decades than it is by noting a step in advance here, a step in retreat there, during any single year of operation. An apparently brilliant discovery of one year may become a mediocre achievement or an utter failure the next year when placed under the scrutiny of scientific investigation or the grueling grind of commercial operation, but over a long period of years the peaks and depressions dissolve into a smooth line and the graph indicates the true direction of the progress that has been made.

GOLD ORES

The first hydrometallurgical process for the treatment of gold ores was the Plattner process in which the gold in oxidized (or dead roasted) ores was dissolved by means of wet chlorine gas and was precipitated by ferrous sulphate, hydrogen sulphide, or charcoal. This process came into commercial use in 1851 and passed out of existence about 1915, unless, unknown to the author, it is still used in Australia. The cyanide process has replaced the chlorination process for good commercial reasons, and it will probably remain the standard and only hydrometallurgical process for the treatment of gold ores for years to come. This process has become so standardized and its refinements are so well known that there is no new development to record.

SILVER ORES

The first hydrometallurgical process, and probably the first metallurgical process of any kind used in America by Europeans, was the patio process for the treatment of silver ores. This was invented in 1557 by Bartholomé Medina, a miner of Pachuca, Mexico. A similar process, so far as the chemistry is concerned, had been used in Europe as early as 1540. It was pleasing to read in the technical press a few months ago the following item: "It is generally considered that the once-popular patio process has gone out of use, but the Noche Buena and Feliz Ano mines in the Totolapam district, about 75 miles east of Oaxaca City, Mex., still have in active operation six patios and are preparing to build six more. Manager MacEwan reports that the extraction by the patio process is unusually high." This is a wonderful record for any metallurgical process—nearly 400 years of constant use without change in procedure or equipment! It is a clear case where "local conditions require local treatment;" excessive freight rates on supplies in and mineral products out, over mountain trails by mule back transportation for a distance of 75 miles, prohibit the use of anything but the simplest of metallurgical operations.

No hydrometallurgical operation for the treatment of silver ores could be more simple than the patio process; the finely ground ore is mixed with water to form a thin mud; common salt and copper sulphate are added to convert the silver minerals into silver chloride; mercury is added to recover the silver as amalgam, from which it is finally recovered as bullion, and the mercury is returned to the circuit. Dissolution and precipitation of the silver are accomplished in one operation in the ore pulp itself.

I place considerable stress on this striking example of metallurgical adaptation to local conditions for the benefit of the younger generation of metallurgical engineers, to whom many of the older processes may seem archaic and consequently are little studied. I wish to impress upon these men the importance of a careful study of local conditions for ore production, metallurgical treatment, and marketing of products, as a primary requisite for the selection of a process for the successful treatment of an ore, regardless of whether that process may or may not be popular and in common use.

Two branches sprang from the patio process as a natural development: One is the pan-amalgamation progress which originated at Washoe, Nev., in 1861, and for a long time it was known as the "Washoe process." This is distinctly

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a process indigenous to the United States, and the last two mines at which it was used were the Commonwealth mine at Pearce, Ariz., and the Presidio mine at Shafter, Tex. At the Commonwealth mine a 77 percent recovery was made on 15 oz. silver ore at a cost of $1.60 per ton, but the process was abandoned for the cyanide process in 1910. At the Presidio mine an 85 percent recovery was made on 18 oz. ore, but the process there was replaced by the cyanide process in 1913. So far as known, this process is no longer used anywhere, but the above mentioned figures show that it has merit and it should not be forgotten. The other offspring from the patio process is brine leaching as applied to silver ores, and of late years to lead ores. This process originated in Germany in 1843 and was known as the Augustin process. It was used to some extent in the United States during the seventies but was never popular and was soon superseded by hyposulphite leaching, which became very prominent in the treatment of silver ores on the American continent from 1868 to 1893 and is still used to some extent in South America. Brine leaching is usually preceded by chloridizing roasting, but this is not absolutely necessary.

Brine leaching of silver ores has been brought into prominence again during the last decade by the development and exploitation of the Holt-Dern chloridizing furnace and by the determined and painstaking effort of the Tintic-Standard Mining Company to treat its low-grade silver ores. Little attention was paid to the base metal contents of the ore at the start, and lead was not desired, but the higher price obtained for this metal during the past few years has stimulated further effort for its recovery and also the treatment of ores with higher lead content.

The recently published record of operations at the Standard mill, Harold, Utah, where this process has reached its highest development, is worthy of careful study. Starting with an acknowledged milling cost of $4.43 per ton under the most favorable operating conditions conceivable, and with recoveries of less than 90 percent of the silver, 65 percent of the lead, and 52 percent of the copper on an ore that should be readily amenable to hydrometallurgical processes, the question immediately arises whether or not the right process has been selected.

The first requisite for leaching silver ores with any lixiviant other than cyanide solution is an efficient chloridizing roast. Efficient chloridizing roasting can be done only in an oxidizing atmosphere. It is difficult to conceive how this condition can be obtained in the Holt-Dern furnace where carbonaceous fuel is mixed with the charge and the atmosphere must be highly reducing until all the carbonaceous fuel is consumed. This statement is confirmed by the fact that the sulphur content in the roasting charge must be maintained near 3 percent in order to prevent fusing or the formation of a matte. In chloridizing roasting at low temperatures, chlorine can be liberated from the salt only by the sulphuric acid radical, and

Stuart Croasdale

the sulphuric acid radical cannot be formed except by the oxidation of the elemental sulphur. The elemental sulphur in the Holt-Dern furnace charge cannot oxidize and function in the liberation of the chlorine until the reducing action of the carbonaceous fuel is removed. The principle of the roasting operation in this furnace is, therefore, fundamentally wrong for chloridizing roasting whatever may be the economies obtained in the furnace construction and operation. From the viewpoint of an outsider, it would appear better to increase the sulphur content of the charge and depend on the sulphur alone for the heat of reaction than to introduce carbonaceous fuel in any form.

Effective chloridization is seldom accomplished on ore crushed coarser than 20-mesh or 0.75 mm. in size—depending of course on how freely the mineral is liberated from the gangue and on the porosity of the gangue itself. In this furnace the charge cannot be crushed finer than 8-mesh without seriously interfering with the draft.

The metals—silver, lead and copper—are finally recovered as metallic precipitates, which are shipped to the local smelting plants as high-grade products instead of being sold as bullion. In short, this brine leaching process as practiced apparently shows little or no profit over shipping the crude ore to the local smelting plants, and I cannot help but compare these results with those obtained by hyposulphite leaching on much more difficult ores at Aspen, Colo., in 1891-1893.

The analysis of the Tintic ore treated is given as follows: Ag, 18.26 oz. per ton; Cu, 0.3; Pb, 5.0; SiO_2, 65.0; Fe, 10.0; CaO, 0.7; S, 3.0; and As, 0.7 percent.

The Aspen ores contained lime and magnesia in quantities that would be prohibitive at the Standard plant, but otherwise the analyses are quite comparable since the silica and barite in the Aspen ores may be classed as "insoluble." The average analysis of over 30,000 tons of ore treated was, Ag, 27.9 oz. per ton; Pb, 2.3; SiO_2, 21.7; $BaSO_4$, 20.9; CaO, 11.0; MgO, 4.25; Fe, 10.0; Zn, 2.85; Cu, 0.16; and S, 8.1 percent.

At Aspen the ore charge was crushed to pass a 30-mesh screen and the chloridizing roasting was done in a Stetefeldt furnace. Metallurgists who are familiar with this old type of furnace know that the time of roasting is limited to a few seconds, while the ore drops from the top to the bottom of the furnace shaft—a distance of 30 or 40 feet. The chloridization of the silver in the furnace during this short time was 43.5 percent; it was a little higher in the flues and dust chambers, making the average chloridization 52.5 percent by the direct roasting operation. The roasted ore was piled on a cooling floor and allowed to remain an average of 102 hours, during which time the chloridization of the silver increased to 79.0 percent.

The Russell process was used, which is a modification of the ordinary hyposulphite leaching. The actual extraction, based on the silver recovered and paid for, was 94.21 percent of the silver in the roasted ore and 85.58 percent of the silver in the raw ore. The volatilization and dust losses were 9.16 percent, which would be fully recovered by present day practice. A commercial test was made on silicious ore from Creede, Colo., which more closely resembles the Tintic ore, and an extraction of over 90 percent was obtained without difficulty by hyposulphite leaching. No effort was made at that time to recover lead and copper except such as was necessary to remove them from the stock solutions. The percentages of recovery on these metals are therefore unknown, but it is certain that they were fully as high or higher than those obtained at the Standard mill. The final products recovered from hyposulphite leaching were fully as high grade as those obtained at the Standard mill and these, too, were shipped to the smelting plants, but the

high-grade silver sulphides were ultimately refined at the plant and the bullion sold to the mint.

Hyposulphite leaching has been abandoned in the United States since 1893 when this country adopted the gold standard, but where chloridizing roasting is necessary, this old process compares favorably with anything now in the field and it might be revived and brought up to date to the advantage of properties where it can be applied.

Lead Ores

It has been predicted by some metallurgists that lead smelting is doomed to be superseded by hydrometallurgical processes. Much has been done in this direction during the last ten years but nothing yet has arisen to justify such an optimistic statement. All hydrometallurgical efforts to treat lead ores have been confiined to brine leaching. Acidified solutions appear to be necessary, and sulphuric acid, directly or indirectly applied, is the only acid that can be commercially used. The presence of sulphuric acid or soluble sulphates in the lixiviant delimits the solubility of the lead, and, unless they are removed, a high extraction of the lead cannot be made, as shown by the results obtained at the Standard plant in Utah where the extraction of the lead is only 65.7 percent. Lead sulphate is formed to a large extent, even in the chloridizing roast, but this readily forms the chloride and dissolves in hot brine. The brine used is a nearly saturated solution of salt and the presence of sulphate soon establishes a solubility equilibrium for the lead salts.

Tainton has developed the most practical process up to the present time. He removes the sulphuric acid radical by means of calcium chloride in the form of bleaching powder. The lead is precipitated from the pure brine solution by electrolysis in a closed cell and the chlorine gas thus liberated is absorbed by slaked lime, which forms the bleaching powder that is used in the leaching cycle for removing the sulphates; this is applicable where electric energy is cheap enough to make the process profitable.

At Bauer, Utah, the Combined Metals Reduction Company is treating the crude lead-zinc middlings from the flotation plant with hot brine solution acidified with hydrochloric acid. The hydrochloric acid is made in a separate plant and then added to the brine. The lead sulphide minerals are attacked—also oxidized minerals when present—and hydrogen sulphide is liberated. The temperature of the lixiviant is maintained at 95°C. The mechanical difficulties of operating on a large scale with a saturated solution of salt, heated nearly to the boiling point and acidified with hydrochloric acid, are almost commercially insurmountable. The lead chloride is separated from the lixivium by cooling and the metallic lead is now recovered by smelting this precipitate with lime.

Copper Ores

It seems strange that the Longmaid-Henderson process has never been applied to raw copper ores. For the past sixty-five years it has been in constant use both in this country and in Europe for the extraction of copper from pyritic residues or calcines by roasting with salt and leaching with water. The use of this process probably will never be extended to the treatment of raw ores because sulphuric acid is now made cheaply in all copper-producing districts or is regenerated to a large extent where electrolytic precipitation is used. The use of sulphuric acid saves the roasting expense.

There is little change to record in the hydrometallurgy of copper; sulphuric-acid leaching continues as heretofore in this country and in South America; ammonia leaching is such a success in the Lake Superior region that its application is being expanded; sulphurous-acid leaching has made no headway, but the combination of salt and sulphurous acid offers possibilities that may find application in other branches of hydrometallurgy as well as in the treatment of copper ores.

The Inspiration Copper Company is now constructing a plant to leach its oxidized and semi-oxidized ores by means of a solution of sulphuric acid and ferric sulphate, according to the method developed by Van Arsdale. A pilot plant of 35 tons daily capacity was operated for nearly a year and confidence in the commercial success of the process has been established. It has been demonstrated "that an active and efficient ferric-sulphate solvent can be regenerated in a non-diaphragm cell by electrolysis with a reasonable yield in pounds of copper per kilowatt-hour, and that the solvent thus made will give sufficient sulphide extraction under proper leaching conditions." In the large plant the ore will be crushed to pass a 3-mesh screen and will be leached countercurrently for nine days with an acid ferric-sulphate lixiviant. This will be followed by washing with water for three days. The copper in the acid ferric-sulphate lixivium will be recovered by electrolysis and the solution leaving the tank house will be returned to the leaching circuit. The copper in the wash water will be recovered by means of scrap iron and the cement copper thus produced may be sold direct, or it may be redissolved in the stock lixivium and converted into electrolytic copper.

Electrolysis of ordinary sulphuric-acid lixivium recovers only 15 to 17 percent of the copper in solution on one passage through the tank house, due to the ferric iron in the electrolyte. Greenawalt has raised this recovery as high as 75 percent by spraying the lixivium in a current of sulphur dioxide gas before electrolysis. This not only reduces the ferric iron but it supersaturates the electrolyte with sulphur dioxide and thereby generates considerable new acid during electrolysis. It has been found advisable, however, not to increase the acidity above a certain point and the final stages of reduction are accomplished by hydrogen sulphide used directly in the electrolyte or used to precipitate the copper as sulphide from the weak solutions, and the resultant copper sulphide is then used as a reducing agent in the original lixivium. This process also has been demonstrated successfully in a pilot plant but has not yet been put into commercial practice.

"Leaching in place" offers much encouragement for further application, whether it be applied to low-grade stope fillings, mine dumps, or the large tonnages of over-burden removed from the porphyry copper mines. The most ambitious effort in this direction has been made by the Shannon Copper Company in their Copper Belle mine at Gleeson, Ariz. Over a year ago the sulphide ore body in this property was set on fire underground, and it is still burning between the 100 and 400 foot levels. When this ore has become sufficiently oxidized, the mine will be flooded and the copper bearing waters will be pumped to the surface for the precipitation of the copper.

Zinc Ores

The production of zinc by hydrometallurgical methods is still confined to sulphuric acid leaching and electrolytic precipitation as practiced at Great Falls, Mont., and at Trail, B. C.

During the present year a pilot plant of 40 tons daily capacity will be constructed to demonstrate the Gordon-Keith ammonia process for the treatment of zinc ores. In this process the roasted zinc ore is treated with "gas liquor." Gas liquor contains 12 to 14 percent ammonia, of which approximately 35 percent is free and the balance is combined as ammonium carbonate.

Zinc oxide is readily soluble in these reagents, and after treating the lixivium with metallic zinc in the usual manner to remove the copper, cadmium, and other impurities, a relatively pure basic zinc carbonate is precipitated by distilling off the ammonia and returning it to the circuit. The zinc carbonate is then heated to convert the zinc into a high-grade oxide and to regenerate the ammonium carbonate in the lixiviant by the carbon dioxide liberated.

A pilot plant to demonstrate the Malm process was operated in Denver for several months during the past year. In this process dry chlorine gas is used on raw complex sulphide ores. The plant was completed for the production of zinc chloride only. Chlorine gas was obtained from the electrolysis of salt. In this territory no market could be found for either zinc chloride or the caustic soda produced, so the plant is closed until electrolytic cells can be installed for the production of metallic zinc from the fused chloride. Metallurgically, the process is said to have been successful.

The flotation process has now become a part of the mechanical concentration of all ores. Flotation concentrates are extremely fine and zinc concentrates of this character are difficult to roast to the oxide in any ordinary type of roasting furnace. Fulton and Read have developed for this purpose a modification of the old Stetefeldt furnace whereby the fine concentrates, previously dried, are suspended in a current of air pre-heated to 800°C. If the furnace temperature is maintained between 900 and 1000°C, no resulphatization of the calcine can take place because this is above the decomposition temperature of zinc sulphate, but if the temperature falls to 800°C. or below in the flues, a rapid resulphatization of the calcine begins. The authors state that "when the aim of the roasting is a practically complete desulphurization, the furnace must be run hot and the calcines and gas rapidly cooled, or separated from each other as soon as they leave the furnace. If the roasting is carried out as a preliminary for sulphuric-acid leaching, as in the electrolytic-zinc process, the sulphating action of the furnace may be used to any desirable degree up to its maximum."

Construction Materials

The Anaconda Copper Company uses ordinary circular wooden vats for sulphuric-acid leaching; the hoops on the vats are covered with lead. After the failure of concrete to resist corrosion in the experimental plant, The New Cornelia Copper Company lined their concrete leaching vats with lead in their operating plant at Ajo. Concrete vats are used in Europe for copper leaching by the Longmaid-Henderson process, but wood has been found most satisfactory in American Practice. Asphaltic materials for the protection of concrete have not been found satisfactory generally, but the Chile Copper Company, at Chuquicamata, uses a special mastic mixture of asphalts prepared by the Barber Asphalt Paving Company. The Standard Reduction Company, at Harold, Utah, has found that concrete made of siliceous (quartzite) aggregate withstands hot sulphuric-acid brine solutions without deterioration in leaching vats and launders, but it deteriorates rapidly in acid absorption chambers for scrubbing flue gasses. The Combined Metals Reduction Company at Bauer, Utah, has been forced to use the wooden double-tank system for leaching with a nearly boiling saturated brine lixiviant containing free hydrochloric acid. Rubber and wood serve as launders. The Inspiration Copper Company used concrete vats lined with lead in their pilot plant when leaching with an acid ferric-sulphate lixiviant and they will probably use the same construction in the larger plant now building.

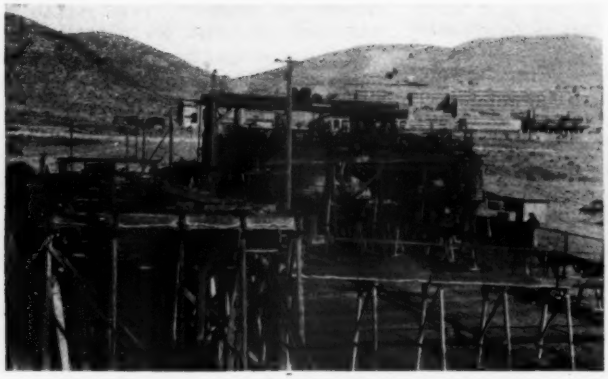
General Observations

A phase of hydrometallurgy that has been noticeable during the past year is the failure to market the products. It has been demonstrated that the Coolbaugh, or sulphatizing, process for the treatment of complex lead-zinc ores can be operated successfully on a commercial scale, but where it is located—at Durango, Colo—there is no market for the zinc sulphate produced. The Combined Metals Reduction Company, at Bauer, Utah, attempted to produce lead bullion from the precipitated lead chloride by substitution with metallic zinc, but no market could be found for the zinc chloride. At the Malm plant, Denver, Colo., no market could be found for either the zinc chloride or the caustic soda produced and the plant had to be closed. The Standard Reduction Company, at Harold, Utah, produced metallic precipitates of silver, lead, and copper by means of chloridizing roasting and brine leaching, but none of these products was pure enough to melt into bullion and they had to be sold to the smelting plants. These few illustrations show the importance of marketing conditions in the selection of a successful process of ore treatment. Consideration of market conditions is too frequently ignored by metallurgists.

Twelve years ago I made the statement that much money and time could be saved by the large companies if more cooperation and interchange of ideas could be maintained among their engineering and research forces themselves and also by periodical consultations with outside talent. Dr. Arthur D. Little has advocated for years the importance of plant visitations by independent engineers in the chemical industry. Every one should read his "Handwriting on the Wall." Two instances that have come to my attention recently will illustrate this point: During the early stages of zinc hydrometallurgy, the zinc sulphate solution was agitated with zinc powder in a Pachuca tank by means of compressed air to remove the copper, cadmium, and other metals. After a certain length of time it was noticed that the copper redissolved to some extent, even in a nearly neutral solution. A visiting engineer happened to be in the plant and suggested to the manager that the air used for agitation might oxidize the freshly precipitated copper sufficiently to render some of it soluble. Mechanical agitation was substituted for air agitation and the dissolution of the copper ceased. More recently, in the same plant, the electrolytic zinc suddenly contained appreciable quantities of lead and the resident management had been unable to trace its source. A metallurgist happened to visit the plant at the time and discovered that in the manipulation of the electrolytic tanks a small but definite amount of corroded lead (oxide or sulphate) was rubbed off and remained in suspension in the electrolyte or was in such a condition that it pulled off with the starting sheets; in any event, lead in this manner became entangled in the deposited zinc. Attention was called to this possible source of contamination and on removal of the cause the zinc was again produced in its former purity. The company profited; the engineer received nothing for his voluntary but valuable advice.

Resident managements too often resent suggestions from outside sources and consider them reflections on their own ability, but the constant grind of commercial operation will dull the best of minds, whereas a visiting engineer might quickly notice sources of trouble or suggest improvements that would pay his fee many times over; at the same time, the professional ethics of any responsible engineer would prevent the divulgement of any trade secrets that would naturally come under his observation. It would pay any industry—chemical, metallurgical, manufacturing, mining, farming or merchandising—to employ outside talent for periodical visits of observation. This has been proved so many times that no doubts can be raised concerning the advantages thus obtained.

Due to the illness of Mr. Arvid E. Anderson, chemist and metallurgist of the Ohio Copper Company of Copperfield, Bingham Canyon, Utah, his article on "Leading Ore Bodies in Place at the Ohio Copper Company" will have to be postponed until a later issue.



Cementation Plant, concentrator in the distance

Photograph showing construction of basins on surface of heap

HEAP LEACHING LOW GRADE ORES AT BISBEE, ARIZONA

Results Obtained By Heap Leaching At Sacramento Hill Demonstrate That At Least 25 Percent Of The Copper Can Be Recovered From Low Grade Ore Containing 0.92 Percent Copper At A Cost Of Approximately 5 1-2 Cents Per Pound

By A. W. HUDSON*

DURING February, 1923, a joint article was written by G. W. Van Arsdale and myself, (†) in connection with heap leaching the low grade ores from Sacramento Hill at Bisbee, by the Copper Queen Branch of the Phelps Dodge Corporation, in which an account was given of the preliminary experiments, views on the chemistry and mechanisms of the method, together with a resume of the final plans which had been adopted for a large scale installation of the method.

Previously some 380,000 tons of low-grade ore, obtained from stripping operations, had been placed on the leaching site which was selected to accomodate approximately 2,000,000 tons of material of leaching grade, when operations at Sacramento Hill were temporarily suspended.

Early in the year of 1924 deliveries of leaching ore were again resumed, and it is the object of this article to relate the progress that has been made since that date.

During March it was decided to set apart a portion of the heap then building, which would be representative of the whole, and to commence leaching operations on this portion to confirm the previous work done on 10,000 tons of similar material. Arrangements were therefore made to completely build one end of the heap and to remove the railroad rails so that once leaching operations were commenced no disturbance would be caused by further dumping operations.

While the building of the heap was progressing a cementation plant of suitable size for precipitating the copper from the solutions was erected, two reservoirs for holding the solutions previous to and after leaching, were excavated, and a flume was built to convey the mine water to the leaching site.

LEACHING SITE AND HEAP

As previously stated (†) the leaching site was chosen because of its proximity to the ore, the contour of the ground, (which has an average of from 3 to 5½ percent slope), and the nature of the floor. The soil is underlaid with caliche and conglomerates which in some places are exposed on the surface and it was anticipated that eventually an impervious bottom would be formed by reaction with the solutions.

Soon after the concentrating mill was put into operation, which is adjacent to the leaching site, slimes were conveyed by launder and distributed over the ground to assist in arresting the seepage of solutions.

CONSTRUCTION OF HEAP

The ore is delivered to the leaching site in steel dump cars of 20 and 25 cu. yd. capacities which dump either side by use of compressed air. Dumping operations were commenced on the sloping ground and with the increase of the heap the track is moved over to the edge.

In constructing the heap, previous ideas have been followed closely with the exception of crushing the rocks to eight-inch size. The larger sizes have been broken with powder at the foot of the heap to from 12 to 18 inches and used for the construction of culverts which are built in advance of the dumping operations, and which serve both for drainage and ventilation.

This heap is nearly completed, there having been delivered 1,800,000 tons of ore containing 33,000,000 pounds of copper.

The area covered is approximately 1800 feet by 750 feet, the depth of the heap being from 6 feet to 32 feet depending on the contour of the ground.

The average analysis of the ore is:

Cu	SiO_2	Al_2O_3	Fe	CaO	S
%	%	%	%	%	%
0.92	63.5	11.2	8.3	0.7	6.8

Late deliveries, however, show slightly higher sulphur (8.5 to 9 percent) and lower CaO (0.2 percent).

The ore as received averages about 0.2 percent acid soluble copper. Irrigating basins 25 feet square have been constructed over 52 percent of the surface area.

A second heap is under construction on adjacent ground and contains 650,000 tons of material.

The portion of the first heap set apart for immediate leaching averages from 10 feet to 25 feet in depth, is the full width (750 feet) of the heap, and contains approximately 200,000 tons of ore. Solutions percolating through the ore gravitate to the front of the heap (750 feet) and join a main drain which traverses the length of the heap, about 1600 feet, terminating in a storage reservoir. From here these are pumped to the cementation plant.

Caliche forms the bottom of the drain and reservoir and apparently there is little loss of solution from seepage.

*Leaching Engineer, Copper Queen Branch, Phelps Dodge Corporation.

(†) Transactions A. I. M. & M. E. Volume LXIX, 1923.

Reservoir above heap and portion of heap

Portion of heap showing culvert built ahead of it

Leaching Operations

When contemplating large scale operations certain assumptions were made which were partly based on previous experience, amongst which were:

1. An average delivery daily of 300,000 gallons of mine water for leaching purposes.

2. Period of extraction. Six years to make a total recovery of 70 percent, divided as follows:

First Year	20 percent
Second Year	12 percent
Third Year	10 percent
Fourth Year	10 percent
Fifth Year	9 percent
Sixth Year	9 percent

Average daily soakage and evaporation, 50,000 gallons. (Soakage is the amount of water taken up by the ore.)

Leaching operations were commenced on September 12, 1924, using mine water which was later augmented with return water from the plant.

During the twelve month period a total of 54,238,500 gallons of mixed water had been used for leaching, while the amount recovered from the heap and sent to the cementation plant was 41,084,750 gallons, showing a difference due to evaporation, soakage, and loss, of 13,153,750 gallons equal to 36,037 gallons per day, or 24¼ percent of the total water to the heap.

The average iron and copper contents of the waters used were as follows:

	Copper	iron Ferrous	iron Ferric	iron Total
Mine water, pct..	.0822	.0203	.0988	.1193
From plant, pct..	.0591	.8389	.0406	.8796

All solutions are measured and sampled for three shifts during the 24 hours, both to and from the heap.

After deducting the copper sent to the heap in the leaching solutions from that received from leaching operations an extraction of 25.16 percent of the copper contained in the irrigated portion of the heap has been shown. Of this amount 21.07 percent had been shipped to the smelter and accounted for up to September 1, the remainder being in process.

One man only is employed to operate the heap.

Cementation Plant

This plant consists of six redwood tanks, 24 ft. in diameter with 10 ft. stave, each containing a false bottom for supporting the iron. Underneath the false bottom is an acid proof stirring arm worked from a shaft in the center of the tank and which is suspended from the top of the tank. This is used for agitating the solution when necessary and for moving the deposited copper to the central discharge on the bottom of the tank. The solution is introduced alongside the agitator shaft and delivered under the false bottom, then flows up through the iron and discharges over a periperal launder into the next tank in series. Each tank is connected to the next tank in parallel by a launder so that any tank may be cut out for separate cleaning or for adjusting the iron. A gantry crane is used for unloading the iron from railroad cars and for filling the tanks. After the solution passes from the last tank it flows to a sump from which the required amount is returned to the heap for leaching, the remainder passing on to a series of 3 ft. by 3 ft. launders built in duplicate where most of the remaining copper is extracted preparatory to going to waste. Large scrap iron of all descriptions is used in the tank, and tin clippings from can factories are used in the launder plant.

The cement copper which is removed from the plant passes to an acid proof classifier where the coarse copper is removed and deposited on drying floors, the fine or suspended copper passing to a thickening tank 24 ft. in diameter, equipped with an acid proof diaphragm pump which removes the thickened cement copper to drying floors, the clear overflow being pumped back into the cementation tank circuit. When sufficiently dry the copper product is shoveled into mine cars and loaded into railroad cars for shipment to the Copper Queen Reduction Works at Douglas.

The main pump lines are 6 and 8-in. standard flanged pipe lined with redwood, the smaller lines being hard lead pipe. Duriron centrifugal pumps are used for handling the solutions which are very corrosive.

This plant is making an extraction of from 93 to 98 percent of the copper, the average content of the head solution for the twelve months being:

Copper, pct.	Ferrous iron, pct.	Ferric iron, pct.	Total iron, pct.
.366	.2028	.2057	.4086

The grade of shipping copper averages about 70 percent. Seven men operate the plant during the 24 hours.

Costs

The total cost per pound of producing the copper for the twelve months' period, including deferred expenses to the leaching heap has been as follows:

Leaching	$0.0112
Cementation	0.0434
Total cost per pound	$0.0546

Summary

The results of the first twelve months treatment of 200,000 tons of ore have demonstrated that at least 25 percent of the copper can be recovered from the Sacramento Hill low grade ore containing 0.92 percent copper by heap leaching, at a total cost of 5.46 cents per pound.

From observation there is little loss of solution by seepage into the ground on the site selected.

Leaching operations are being continued on the same portion of the heap, and from results obtained during the past three months it is apparent that a further 12 percent extraction of the copper will be more than realized for the second year of operation.

A study of the heat treatment of oxidized ores followed by concentration is being conducted at the Salt Lake City experiment station of the Bureau of Mines. The purpose is to develop a process for the separation of lead and zinc in oxidized ores that are not amenable to any other method of treatment. Several tests have been made, using this process, and the results were very encouraging.

NOTES ON COPPER LEACHING

Hydro-Metallurgy No Longer Questionable Method — Resultant Low-Cost Copper Indicates Value of Leaching Plants In Other Than Low-Grade Oxidized Ores — Installation Cost High But Plant Is Equivalent To Concentrator Plus Smelter Plus Refinery, Thus Balancing Costs

By G. W. VAN ARSDALE*

THIS article is not meant to be a description of leaching methods in general or of any specific process, but is presented as a series of notes giving the author's opinion as to the reasons for the present development of leaching, with something of its present comparative status and prospects. As such, they have nothing new to those familiar with the subject, but may serve possibly to give a new viewpoint and a basis of discussion to those who have not specialized in this line of metallurgy.

Strictly speaking, leaching means dissolving and removal only of a soluble constituent, usually by the application of water, without regard to the subsequent treatment or precipitation of what is removed. Thus, it is correct to say that "black ash" is leached to remove sodium carbonate, or that crude sodium nitrate is leached to recover this chemical. When applied to the wet treatment of copper ores, however, leaching has come to mean the complete process including precipitation, and since the use of the term is more or less general, it seems hardly worth while to insist on the more accurate names, hydrometallurgical or wet methods. However they may be called, their definition in general is that of processes in which an aqueous solvent is brought into contact with copper ore, the resulting solution removed, the ore washed, and the copper finally removed from the solution in a form suitable for shipment or further treatment. Solubility relations are obviously vital for both hydro and pyrometallurgy. It happens that many copper compounds are soluble, while most gangue constituents are not; it also happens that matte is practically insoluble in molten silicates. Without these two basic facts of solubility and the reverse neither leaching nor modern smelting would be possible.

Copper leaching is quite recent as compared with smelting methods, since the production of copper by smelting of some sort antedates historical records, and, according to the chronology in Hoover's translation of Agricola, also preceded the production of metallic iron; this being the only possible precipitant of copper up to quite recent times. This well known reaction of the separation from solutions of metallic copper on the immersion of metallic iron is one of the earliest known chemical facts, and it has been stated that this method of making copper has been in use at Rio Tinto for several hundred years and possibly longer, perhaps roughly corresponding to any period, after the discovery of the reaction, during which iron and labor was cheaper than the copper made.

The history of copper leaching may be divided into several periods. For the first period, starting in England about 1800, there was practically but one major problem, that of getting the copper from "pyrites cinders," the residues from the roasting of Spanish pyrites for making sulphuric acid. The development of the main process devised for this began in England, and many names prominent in the early history of heavy chemical making in Great Britain are connected with it. In this country, the use of the method, in practically its original form of a roasting with salt, leaching with acidulated water, and precipitation with iron, persisted up to the time when the discovery of the Frasch process for raising the Louisiana sulphur by melting in place of pumping to the surface, dominated the domestic market for sulphur and excluded Spanish pyrites, the most important raw material for the process.

The second period of development of wet methods was due mainly to another and a larger problem, and the end of this period may be taken roughly as the date of the beginning of the electrolytic refining of copper in this country, say about 1880. Before this time, there was no very satisfactory method of separating gold and silver from the bullion obtained by smelting copper ores carrying precious metals. Obviously this was a very important problem, and a number of the older methods, described in the literature of leaching, had this as one of their main objects, among these being the Hunt & Douglas methods. Since electrolytic refining of copper bullion was a complete and satisfactory solution to this difficulty, this incentive to the development of copper leaching at once disappeared.

Following this date, another set of conditions gradually came up, some of these being favorable to copper leaching and leading to some experimental progress. Exhaustion of high grade surface deposits soon began to be felt. The discovery and development of converting copper matte to bullion, beginning roughly at about this time, resulted not only in the giving up of smelting by direct reduction of ores to black copper and the possibility of treating sulphide ores directly, but also opened the way to the treatment of low grade ores by concentration and the smelting of the resulting concentrates. However, concentration by gravity only was very imperfect and total recoveries were low; and the possibility of treating "slime tailings" as well as low grade silicious oxidized ores, unsuitable for either smelting or concentration, afforded some impetus to leaching development. The invention and development of flotation definitely removed the first of these problems, leaving as the apparent field of leaching only low grade oxide ores. As is usual on the discovery of a new method, its commercial limitations were not definitely recognized, and for a number of years experiments were made to adapt flotation to treating mixed oxide and sulphide ores, but no generally applicable method resulted from these attempts. It therefore began to be generally recognized that flotation, while admirably adapted to high efficiency in its own field, so far did not show definite promise of being the solution of several important problems.

The next period in the history of copper leaching, the present one, may be called that of the application of engineering. Chemical knowledge of possible solvents and methods of precipitation and a host of patented processes existed and was ample so far as it went; but of little practical value without the devising of methods for handling ores and of the apparatus for treating them on a very large scale; together with the testing of these and process details on a sufficiently large scale for a long enough time to prove their practicability. This necessarily involved the spending of large sums of money, and modern copper leaching owes its present successful status as an established method and its possibilities for the future very largely to the courage and vision of those in charge of large interests who have been willing to spend the hundreds of thousands of dollars needed to accomplish these ends, in addition to the much larger hazard of investments in large properties of little potential value, unless wet methods of

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Construction of Leaching Plant, Inspiration Consolidated Copper Company, December 1, 1925

treatment proved eventually successful. Therefore, while some individual detail patents are of importance, it is quite proper that copper leaching should not be in the position of being dominated by practically complete patent control, as was the case with flotation.

As a result of the process made during the last period, therefore, it appears definitely shown that hydrometallurgy is no longer a matter of demonstration of methods, but is now a question of commercially possible conditions. It would seem also that the fact that leaching plants now in operation have yielded low cost copper would point strongly towards further extension, possibly into fields other than low grade oxidized or mixed ores.

The question of what constitutes suitability of an ore for leaching evidently requires something in the way of definition. As to this, it can be said that the possible field of leaching is much larger than formerly; obviously, however, this question can be discussed in a general way only, and definite conclusions made only as the result of the study of specific problems. One of the first conditions of importance is the presence or absence of gold and silver. None of the methods now in operation or of those on which sufficient work has been done to warrant their consideration under present conditions are capable of making good recoveries of the precious metals. This can be easily understood for gold for the reason that any commercial leach liquor will contain ferrous sulphate, which is a precipitant for gold. Ferric sulphate is a solvent for gold, and under some conditions for some solutions there may accordingly be an equilibrium resulting in a partial extraction of gold. Generally speaking, however, while copper may be recovered from an ore otherwise adapted for leaching, a subsequent treatment, say by cyanidation, will be necessary in case the ores carry enough precious metals to warrant this. This may work both ways; that is to say there are ores otherwise adapted to cyaniding but carrying so much copper that the cyanide consumption is too high. Copper can be recovered from such ores, and their treatment is therefore metallurgically possible and is conditioned only by the commercial factors involved.

There are possible conditions under which a copper ore, practically free from gold and silver, and adapted metallurgically to ordinary concentration, may yield equal or better extractions and cheaper copper by leaching, especially if such an ore has chalcocite as the principal copper mineral and any appreciable amount of oxide copper; but if such ores carry also gold and silver the balance will probably be in favor of concentration. However, there are also possible commercial conditions under which it may pay better to treat copper concentrates by leaching than by smelting, converting and refining.

The question of the kind of copper mineral in an ore obviously determines in large measure the kind of solvent and the leaching method, but is not of itself a determining factor in deciding whether or not it is metallurgically possible to use wet methods, because nearly all ordinary copper minerals are soluble in possible solvents, and those sulphides which are not easily acted on may be rendered amenable by roasting. The following general statements may be made with regard to solubility. Compounds of copper may be divided into non-sulphide or oxidized and sulphide forms. All of the commonly occurring oxide forms, with the exception of cuprous oxide, metallic copper and some forms of chrysocolla are easily soluble in dilute sulphuric acid, and, by the addition of ferric iron to the solutions, cuprous oxide, metallic copper and most forms of chrysocolla are readily dissolved. Ammonia leaching does not dissolve copper from the ordinary chrysocolla. However, a modification of ammonia leaching, recently mentioned in news items, has been worked out by engineers of the Mineral Separation Co., for a large African deposit, whereby it is said chrysocolla may be treated.

All sulphide forms of copper are quite insoluble in either dilute acid or ammonia liquors. Direct leaching without roasting, however, is possible for some sulphides by the addition of an oxidizing agent, for example, to dilute acid. The solubility of sulphide compounds with such liquors depends mainly on the sulphide compound, the character of its occurrence in the ore, the fineness of grinding, and on the time and temperature of application of the solutions. Chalcocite or other similar sulphides not carrying iron are the most readily attacked. Chalcopyrite is the most refractory to solutions carrying ferric iron. This is probably due to the fact that such solutions are without action on pyrite, and the FeS_2 constituent of the chalcopyrite inhibits complete solubility of its copper.

Chemically the most important gangue constituents of an ore are lime (and magnesia) and alumina and iron in soluble forms. It is also theoretically possible for silica to be in a form capable of being soluble in ammonia, thereby fouling this solution and increasing consumption of reagent. The soluble constituents of an ore of course determine the acid consumption, which is a matter of treatment costs. Roughly there are in this respect three classes, first those in which acid consumption is too large for commercial conditions, and which can be leached by ammonia only if at all; second those in which the dissolved elements are high enough to require a discard to maintain the solutions at standard composition; and third those in which the dissolved constituents are low enough so that standard composition of the liquors may be kept balanced by the dissolved salts in the moisture discarded with the final tailings. The Ajo ores belong to the second class; while the leaching ores of the Inspiration Co. belong in the last class, and leaching may be done on these without appreciable discard.

In order to visualize these statements, let us assume an ore with two percent or forty pounds per ton of recoverable copper, and that acid can be had for $15 a ton or three-fourths of a cent a pound of actual acid. The following table may then be made in which it is assumed the 1½ pounds of acid per pound of copper are regenerated by electrolysis, the new acid per ton of ore being the difference between this and the total actual consumption.

Lbs. new acid per ton ore	Cost per ton @ ¾c per lb.	Equivalent amounts of soluble Fe	Al_2O_3	CaO
20	0.15	0.55	0.34	0.55
40	0.30	1.10	0.68	1.10
60	0.45	1.65	1.02	1.65
80	0.60	2.20	1.36	2.20
100	0.75	2.75	1.70	2.75
120	0.90	3.30	2.04	3.30
140	1.05	3.85	2.38	3.85
160	1.20	4.40	2.72	4.40
180	1.35	4.95	3.06	4.95
200	1.50	5.50	3.40	5.50

Assuming that iron is dissolved as $FeSO_4$, obviously CaO and Fe are equal in acid consumption and resulting cost, while an equal amount of Al_2O_3 consumes more than either. One pound of soluble alumina requires approximately 2.88 pounds of acid as against 1.75 pounds of acid for a pound of iron or lime, the ratio being 1.64:1. This is the basis of the statement often made that alumina is more harmful in leaching than lime, but is not the whole story, since the result of the action of acid on lime is the comparatively insoluble $CaSO_4$ which does not accumulate in solution to a degree sufficient to cause trouble, while the reverse is true of alumina.

In any cyclical process, the amount of discard required to keep the solutions in balance is a very important matter in determining the selection of a flowsheet, the suitability of an ore, and the probable cost of treatment. A discard or "bleeding off" of solution is a removal each cycle of the amount of solution required to prevent accumulation of impurities. Usually such discards are treated by cementation, the resulting cement copper being either shipped as such or absorbed into the main circuit by the solvent action of ferric iron. It is obvious that with increasing percentages of soluble iron and alumina in an ore, there will be a point at which a large or even a prohibitive discard of solution per cycle will be needed. Since cementation usually costs more than electrolysis this result will have a proportional effect on the total cost of production.

The following illustrates these statements. Let us assume an ore with 40 pounds per ton of recoverable copper, also that an electrolytic process is used, the solution to the tank house carrying 2.5 percent copper and 2 percent total iron at the beginning of operations, 0.5 percent copper being plated out and the exit solutions to leaching therefore having 2 percent copper and 2 percent total iron. Of course the ratio of solution to ore will have to be adjusted to reproduce the 2.5 percent copper for the next cycle, that is to say 40 pounds of copper dissolved (or of any other soluble element) is equivalent to an increase of 0.5 percent in this element in the solution after leaching. Now, if we assume that an equal amount of iron, 40 pounds, is dissolved from the ore, then the increase of iron in the solution will also be 0.5 percent, giving 2.5 percent total iron. In order to keep the coal iron in the solution at the assumed figure of 2 percent, under these conditions it will be necessary of course to discard 1/5 of the solution and replace this amount with water or solution free from iron. Under these conditions, the tank house production would be reduced 20 percent and the amount of cement copper produced would be 20 percent of the total output. With a constant percentage of copper it is obvious that the amount of discard and the resulting production of copper as cement will be less as the percentage of dissolved impurity becomes higher. Therefore from the viewpoint of keeping cement copper at a minimum it is better to let dissolved iron and alumina reach as high percentages as they can be carried without bad effects before making regular discards.

The physical characteristics of an ore, as well as its chemical constituents are, of course, important in determining its suitability and the choice of a method, and a flowsheet ready for the design of a plant is the result of selection of specific values for often a considerable number of more or less interlocking variables. Since the best value for each variable can be selected safely only as the result of tests made on a sufficient scale even for a well known process, it is evident that decision as to the practicability of leaching for any problem and the suitability of any specific ore cannot be made safely without the appropriation of sufficient money for adequate tests.

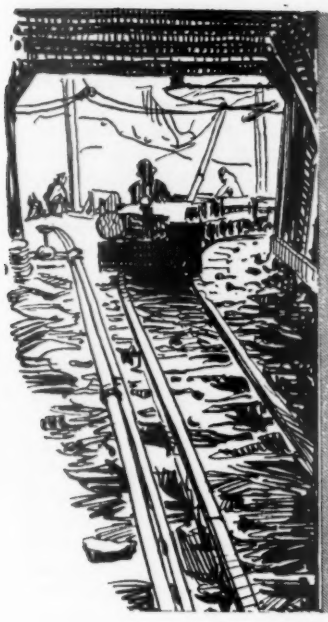
A survey of what we may call modern copper leaching would include a study and description of leaching in place, of heap leaching, of the several established methods for treating oxidized ores, of methods for treating mixed oxide-sulphide ores, and of the ammonia process. Improvements in and further applications of these and possibly other wet methods can doubtless be expected, especially since it seems certain that the copper industry in this country in the next few years must face the necessity for reduction in cost of production and of the benefication of lower grade ores.

Some general statements may be made with regard to installation and operating costs of copper leaching. Installation costs are high as compared with other single metallurgical operations, but it should be kept in mind that finished copper may be produced by a leaching installation using electrolysis. Under favorable conditions therefore a leaching plant may be the equivalent of a concentrator, plus a smelter, plus a refinery, since the same product is turned out. As to actual installation costs, a number of published statements have given the cost of the new Inspiration leaching plant as $6,000,000 for a capacity of about 7,500 tons of ore per day. Accordingly this is equivalent to $800 per ton of ore treated per day, or $80,000 per ton of copper produced per day.

As to production costs, it has been said above that under favorable conditions leaching will give low cost copper. That this is possible may be seen from the following:

Concentration, Etc.:	Leaching:
Mining	Mining
Crushing	Crushing
Concentrating	Leaching
Smelting	
Converting	Precipitation
Freight	Freight
Refining	
Melting	Melting
Seliing	Selling

The above parallel columns give the main cost items for an ore treated by concentration, etc., and one treated by leaching. For the same grade of ore and for equal recoveries, in comparison the items of mining, freight, melting and selling may be omitted, since they are equivalent. For the remaining figures, crushing for leaching is usually decidedly coarser than crushing for concentration, and crushing plus leaching will usually (*Continued on page* 131)



COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Coal Mining Industry

FACTORS GOVERNING THE CHOICE OF A FAN

Costly Mistakes May Be Avoided By Thorough Investigation Of Conditions New Fan Must Meet, Keeping In Mind Relation Between Volume And Pressures, With Consequent Power Consumption, And By Taking Full Advantage Of Services Of Skilled Ventilation Engineers

By G. E. LYMAN*

THE usual discussion of the factors that govern the choice of a fan so often resolves itself into an intricate mathematical treatise that it leaves the average mine official in a state of complete bewilderment. Such treatment of the subject, no matter how fascinating to those interested in the laws that govern the flow of liquids, and notwithstanding its very real value to those engaged in the designing of fans, is nevertheless of little practical use to the average operating official upon whom devolves the responsibility of making the choice of ventilating equipment. The chances are that long ago he made a perfunctory study of these matters, retained it in mind long enough to pass his school examinations, or to get his certificate as fire boss or mine manager, and then as promptly forgot it all, and it is perhaps as well that it should be so, for there is no greater fallacy than that which gives credit for real ability to those whose chief accomplishment is the memorizing and quoting of mathematical formulæ. The exceptional individual who possesses an understanding of the proper use of the mathematical data that fills every reference book, and who applies it correctly in his practical work is indeed an outstanding figure, but investigation even of his methods will probably disclose that he burdens his mind with only two or three of the simplest and most fundamental of the laws of mine ventilation.

For those who are interested in the elementary considerations that govern intelligent fan design, it may be said that it has been ascertained through much laborious laboratory work, and fully demonstrated in practice, that the intake area of a fan should be approximately twice the equivalent orifice of the mine. It is first necessary therefore, when approaching the subject from this angle, to ascertain the equivalent orifice of the mine, and this can only be calculated from the pre-determined data required for its ventilation. For instance, if it is assumed that the ventilating requirements of a proposed operation will be 150,000 cu. ft. per minute at a water gauge of three inches, the area (A) of the equivalent orifice will be determined by the following formula:

$$A = .0004 \times \frac{\text{Volume per minute}}{\sqrt{\text{Water gauge in inches}}}$$

The constant, .0004, is based upon the assumption of .62 in Murgue's formula as the "vena contracta" of the flow.

Application of the above formula to the case assumed indicates an equivalent orifice for the mine of approximately 35 sq. ft. The intake area should therefore be approximately 70 sq. ft. In the ordinary type of mine fan with an intake on each side there would be required for each opening approximately 35 sq. ft. area. The diameter of a circle containing 35 sq. ft. is approximately

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6.66 feet. It has been found good practice to make the intake areas about three-fourths the diameter of the fan wheel. This in turn would indicate a fan wheel 8.88 feet in diameter as the proper size to use, and conforming to standardized manufacturing practice the wheel would be made nine feet in diameter.

With the proper diameter obtained as above, the next step is to ascertain the proper width of wheel to most economically handle the desired volume of air. This involves consideration of both volume and pressure and may be very conveniently determined by using the theoretical peripheral speeds of a fan for the water gauge in question, and divide this item into the volume, and as a matter of convenience call the factor so obtained the DW of the fan, or diameter of the fan x the width. With our assumed water gauge of 3-in., a peripheral fan speed of 4815 feet per minute is indicated, this being obtained from the following formula:

$$\text{Velocity per second} = \sqrt{\frac{\text{Water gauge in inches} \times 5.2 \times 32.2}{W}}$$

In the above formula W represents the weight per cubic foot of air, and in this instance has been assumed as .078. The other constants will be readily recognized. Application of this formula gives the above theoretical speed.

The assumed volume of 150,000 cu. ft. per minute divided by the peripheral speed as above calculated, gives approximately 31 for the DW of the fan. Since the fan is to be 9 inches in diamater the width would accordingly be 31 divided by 9, or 3 4/9 feet, which would ordinarily be made 3½ feet in order to keep the wheel in accordance with the usual manufacturing standards adopted by fan builders in varying the widths.

The actual speed of the fan to produce a 3-in. water gauge is calculated from the theoretical speed of 4,815 as used above. Assuming the fan to be about 81 percent manometric efficiency, and keeping in mind that the pressure varies as the square of the speeds, it may be simply calculated by extracting the square root of the efficiency which gives us 0.9, and dividing into the theoretical speed, indicates an actual speed of 5,350 feet per minute. Since the 9-ft. wheel has a circumference of 28.27 feet, the number of revolutions will be approximately 188 per minute.

If desired to direct connect the fan to an engine the above speed would very likely be objectionable, and it might be desired to secure an efficient fan to deliver the above duty at a speed not to exceed 155 revolutions per minute. Since it has just been determined that an actual peripheral speed of 5,350 ft. per minute is necessary for the 3-in. gauge, the circumference of the fan wheel to run at 155 revolutions per minute would therefore be 5,350 divided by 155, or 34.5 which is practically equivalent to a diameter of 11 feet. In this case, however, the wheel must not be built 3 ft. 6-in. wide because the DW as before determined is 31, which divided by 11 gives a calculated diameter of 2.8 feet, which would be made 3 inches in order to adhere to standard manufacturing practice.

The above calculations are representative of the practical short cuts used by some of the leading designers of ventilating equipment, all of which are so worked into their standard performance ratings for their diflerent sizes that the ordinary individual need not concern himself about them. For those who are interested in the derivation of the different formulæ, and the manner in which they have been modified to meet practical conditions, there is ample material for study in the many theoretical publications on the subject. Fortunately, however, the designing of mine fans has been brought to such a point of perfection, and their performance under different conditions has been so accurately ascertained, that the operating official need go no further than the bulletins of the leading makers to secure his information. As a matter of fact, his chief attention should be concentrated upon making an accurate determination of the duty required and the conditions under which it is to be delivered. To do this in the case of a projected development involves difficulties and uncertainties that can only be very roughly calculated in advance; in fact, the most laborous calculations to determine the resistance of a given layout of workings will approximate the actual situation as later developed, only to the degree that a good guess has been made as to the proper coefficient of resistance to apply.

The ideal conditions for mine ventilation would be obtained where the workings progress uniformly from the shaft bottom in an ever widening circle, thereby keeping the distribution of the volume and distance of travel of the current symmetrical on all sides. In keeping with such ideal conditions the air cources would be always maintained at full area, free from obstructions, and with overcasts, doors and stoppings throughout the mine free from leaks. Under such conditions the ventilation requirements could almost be reduced to a mathematical certainty and fans of proper design selected for the specific duty required. The volumetric requirements of the new mine, when it has once reached the stage of full development, would not further increase, and it would only be necessary to gradually increase the pressure as the length of air course increases, in order to send the same volume of air to the face. Every operator knows, however, from his own sad and costly experience, just how far short of this ideal we fall in actual practice, and how a constantly increasing volume is required of the fan to make up for the losses through defective doors, overcasts and stoppings. This in turn calls for a steady increase in the pressure in order to deliver the increased volume, which alone is ordinarily much greater than the legitimate pressure increase required to take care of the additional length of travel. We have, therefore, even in the best and most efficiently maintained properties, a slow and constantly increasing duty required of the ventilating equipment. At first glance this would seem to place an impossible performance on the fan, having always in mind its operation at maximum mechanical efficiency. Such operation of any class of equipment however, must often be sacrificed to some degree to meet considerations of reliability and safety. Such sacrifice, in the case of a well designed fan, is not as serious under some circumstances as might be supposed. For instance, the performance of one of the well known makes of fan, 10 ft. x 4 ft., is quite uniformly as follows:

Volume	Water Gauge	R.P.M.	Brake Horse Power	Mechanical Efficiency
100,000	.81"	89	17.1	75%
150,000	1 83"	133	57.7	75%
200,000	3.25"	177	136.5	75%
250,000	5.06"	221	266.4	75%
300,000	7.32"	266	461.3	75%

It will be seen from the above that if the volumetric requirement of the mine increases anywhere near the corresponding mathematical ratio to the water gauge, there is no appreciable loss of efficiency.

This fan could, of course, be speeded up until such an excessive amount of air would be passed that its mechanical efficiency would begin to fall rapidly. It is an exceptional mine, however, that will permit the passage of as much as 300,000 cu. ft. at a water gauge within the limits of practicability, so this contingency would hardly be encountered under our assumed case where the volumetric requirements increase regularly with the water gauge.

By way of contrast with the foregoing, and as an example of conditions only too often met in operation, let us assume that the same fan has been purchased and installed on the strength of the manufacturer's guarantee rating of 200,000 cu. ft. at 3¼-in. water gauge, with a mechanical efficiency of 75 percent, only to find that the mine resistance permits the passage of only 100,000 cu. ft. at this pressure. The fan must necessarily run at about 177 revolutions

to produce this pressure, and since only 100,000 cu. ft. is passing through the mine, a considerable amount of air is simply being churned around, and the efficiency thereby lowered. Instead of getting the guaranteed efficiency of 75 percent (and which the fan is perfectly capable of delivering) only about 60 percent will be obtained. The practical effect of this on power bills is readily apparent.

Let us now turn to the other and rather improbable extreme, and assume that the same fan has been selected for the same duty, and installed at a mine whose resistance is so low as to permit the passage of 300,000 cu. ft. at the desired water gauge of 3¼-in. In this case it will be necessary to somewhat increase the speed to obtain the desired pressure, because under these conditions the fan would be too small for the mine characteristics. It would accordingly operate at much lower mechanical efficiency than specified, giving only about 64 percent instead of the 75 percent that would be readily delivered under proper conditions. Under such circumstances it would be very easy to overload the driving motor on account of the excessive amount of air being passed.

It may be proper at this point to call attention to the fact that most practical men do not realize, nor understand how it can be so, that the load on a *constant speed fan* is maximum when discharging direct into the open air, and decreases as the mine resistance increases, until it reaches a minimum when the outlet of the fan is entirely closed.

The same 10 ft. x 4 ft. fan that we have been considering in the above examples could readily be driven under test conditions at varying speeds, so as to hold a constant water gauge when delivering the same volumes as in the preceding table, but with a radical change in the mechanical efficiency obtained, as follows:

Volume	Water Gauge	R.P.M.	Brake Horse Power	Mechanical Efficiency
100,000	3.25"	177	85.3	60%
150,000	3.25"	177	109.5	70%
200,000	3.25"	177	136.5	75%
250,000	3.25"	183	178.0	72%
300,000	3.25"	196	240.	64%

It is evident that the normal mechanical efficiency of which the fan is capable is only being delivered when a volume of 200,000 cu. ft. per minute is being produced at a water gauge of 3.25-in. For delivery of less volume at the same water gauge (which implies more resistance) this particular fan is too large, and conversely, for larger volumes at the same pressure (against less resistance) it is too small, and all this notwithstanding the fact that it will operate at the same maximum mechanical efficiency throughout the complete range of volumes and pressures indicated in the first statement.

Study of the comparative performance of the same fan under the different conditions illustrated will emphasize the necessity of care in determining the conditions under which any contemplated installation will have to operate.

The ventilation during the period of sinking and development is usually handled temporary, and more or less portable, ventilating equipment. When the mine is developed to its projected tonnage it is frequently argued that a relatively small fan should be installed for the first part of its life and a larger one installed later for the remaining life, on the supposition that greater average mechanical efficiency would be secured throughout the entire life of the property. It may under some circumstances be possible to figure a legitimate saving by so doing, but reference to the above examples of fan performances under varying conditions clearly indicates that ordinarily it is impossible to keep any size fan operating for any considerable period under changing conditions at its maximum efficiency, except where the volumetric requirements increase in proper proportion to the water gauge. Careful consideration of this fact leads to the conclusion that the somewhat doubtful economy to be obtained from installing a small fan at the start is more than offset by the advantages of reliability, safety and greater range of duty that accrue to the original installation of a fan large enough to work out the entire coal field. In fact, conditions that could easily be encountered might make the early installation of a small fan result in a distinct operating loss. Let us assume, for instance, that a mine will eventually require about 200,000 cu. ft. at a 3-in. water gauge for its maximum requirements when approaching the limits of its coal field. For the first few years 100,000 cu. ft. will probably be ample, and a 6-ft. fan will readily produce this volume. It will be very evident that the gauge must be kept less than ¾-in. for 100,000 cu. ft. if it is expected to get 200,000 cu. ft. at not to exceed 3-in. gauge in later years. The data above given indicates that a well designed fan is just as efficient mechanically when producing 100,000 cu. ft. at ¾-in. gauge as when handling 200,000 cu. ft. at 3-in. gauge. However, the equivalent orifice of a mine having a capacity of 100,000 cu. ft. at ¾-in. gauge is about 46 sq. ft. If a 6-ft. fan is installed for the first few years it can be shown as per previous calculations that it has a total inlet area of 31 sq. ft., which is much less than the equivalent orifice of the mine, whereas the inlet area should be about double that of the equivalent orifice. Therefore, the small fan will operate at approximately 30 percent efficiency and require about 39 H. P., while the large fan for the same duty would use 16 H. P. or less, making a saving of approximately 23 H. P. which would indicate under average power prices a saving for this work in favor of the larger fan of at least $2,000 annually.

It is the writer's belief from practical considerations that it is preferable, both from an operating standpoint and as a matter of ultimate economy, to install the permanent fan at the start of sufficient size to handle the maximum requirements of the entire coal field. This will give the operator the added margin of safety and reliability that comes from operating an important piece of equipment far blow its maximum capacity, and at the same time without any extravagant sacrifice of mechanical efficiency.

Lest all the foregoing be confusing to some, let the writer say that he would choose a fan for a new operation by the following process:

First. Determine maximum volumetric requirements, based on the number of men and animals to be underground, amount of gas, desired margin of safety, etc.

Second. Arbitrarily fix the maximum water gauge to be carried, based on practical experience in the ventilation of similar workings of equal extent, and make reasonable allowance to meet emergencies. (It has been our experience that a water gauge over 3 inches is impractical and unduly expensive in power consumption.)

Third. Determine size and width of fan by reference to manufacturer's guaranteed ratings and select accordingly.

Fourth. Install permanent fan so as to be completed by the time the mine is developed to its full tonnage.

Fifth. Decide method of drive, type of installation, etc., by local conditions, always remembering that the installation should be strictly fireproof in every respect.

The absence of complicated calculations in the above does not imply any lack of appreciation of the mathematics of ventilation. Precise scientific methods should invariably be applied wherever the various factors themselves admit of precise determination. There is no use wasting time on intricate calculations, however, when so many uncertainties must be taken into account as in this case. The most laborious calculations to determine the resistance of a projected operation will not give the sure and certain results of practical value that can be quickly arrived at by drawing upon experience in the actual ventilation of similar properties.

On the other hand, no such uncertainty applies when it comes to selecting a new fan for an old and going property, because the volume in present circulation and the water gauge required to produce it admit of ready measurement, and indicate precisely to the experienced man just what any new fan will do. It would be well for the operator to pause at this point, however, and determine whether a new fan will really give him relief. If it could only be understood and thoroughly kept in mind that the volume varies directly as the speed, the pressure as the square of the speed or volume, and the power as the cube of the speed or volume, many bitter disappointments and useless expenditures for new equipment would be avoided. Lack of understanding of these elementary points have time and again led to the purchase of expensive equipment, when, as a matter of fact, the only practicable way of increasing the ventilation lay in reducing the resistance of the mine itself. It is surprising how many mining men, well informed on most matters, fail to comprehend that any mine will only pass a certain volume of air at a given water gauge, regardless of what type of fan is used to produce it. The result has been that old type fans have been condemned and new equipment installed, only to get exactly the same water gauge and volume as delivered by the old fan. It should be remembered that with the resistance of the mine remaining unchanged, no fan can be obtained that will put more air through the workings than the old fan has been doing without raising the water gauge proportionately. This in turn calls for increased power expenditure, and even if the power cost can be handled the heavy pressure will make it almost impossible to maintain tight doors and stoppings.

As a practical example let us consider a mine ventilated with an old type fan producing 100,000 cu. ft. at a water gauge of 2-in. If adequate ventilation demands 150,000 cu. ft. it can only be put through the mine by installing a fan capable of handling this amount of air at a pressure of 4.5-in. This pressure is excessive in power consumption, which would be almost 3½ times as great, and also in maintenance cost of airways, and the remedy obviously lies in reducing the resistance of the mine, in which case the old fan will probably be able to furnish adequate volume. The resistance can be reduced in three ways:

1. By increasing the number of splits.
2. By cleaning the falls or obstructions out of the air course and thereby enlarging the area.
3. By providing an air shaft or other outlet at the face of the workings.

Frequently the first two methods are impractical, leaving only the provision of additional outlets to be considered, and while this is expensive in itself, yet its results are certain, and by adopting this course the operator will be saved the expenditure required for a larger fan which, when completed, would not improve his present condition.

There are other considerations in the choice of a fan that have been so thoroughly demonstrated in practice as to become almost standard practice everywhere. Whether to use an exhaust or blowing fan is generally decided by whether the mine is gaseous or otherwise, it being recognized that the exhaust system has many advantages for gaseous workings. Likewise the advantages of the blowing system for operations relatively free from gas are too well known to need elaboration here.

The flexibility and safety features involved in being able to reverse the direction of the air travel are of sufficient importance to thoroughly justify the relatively small additional expense of making the fan a reversible installation.

The lower the water gauge the larger the fan should be for a certain specific volume. The resistance of the average mine unfortunately is such that this point seldom forces itself upon our attention.

The small high speed fans are cheaper to purchase and install than the larger and slower running types. The latter are preferable, however, from every consideration of reliability and safety. They also operate more efficiently under a wider range of duty than the small fans. While a small fan can be made to deliver a tremendous volume it is only done at the expense of extravagant power consumption, and it must be remembered that there is nothing much more inefficient than a small fan working far above its rated capacity.

It sometimes happens that a mine will have adequate ventilation in all sections except one long remote split, while the other splits are receiving a satisfactory volume. To speed the fan up would increase the pressure on all the air entering the mine with a corresponding heavy increase in power consumption out of all proportion to the benefit gained. Under such conditions a booster fan is the logical and practical solution, notwithstanding much widespread prejudice to the contrary. The booster will permit the pressure to be increased on the remote split and the volume in circulation increased without increasing the speed of the main fan. Such installations, installed in a fireproof manner, have a legitimate function to perform but should never be adopted instead of maintaining adequate air courses.

If the operator will first thoroughly ascertain the conditions against which the new fan will have to work, and keep in mind the inexorable relation between volume and pressures, and what it means in the way of power consumption, and at the same time give adequate heed to the advice of engineers skilled in ventilation work, he can reasonably expect to avoid the unnecessary and costly mistakes that are even yet so frequently made in the selection of ventilating equipment.

METHODS AND COSTS OF ROCK DUSTING

STEADY progress in the movement for the rock-dusting of bituminous coal mines as a means of preventing or limiting disastrous coal dust explosions is indicated as the result of an investigation conducted jointly by the Bureau of Mines of the Department of Commerce and Carnegie Institute of Technology, Pittsburgh, Pa. Whereas at the beginning of 1924 few coal mining companies operating in the United States had done thorough rock-dusting by September, 1925, 102 companies in 12 states had rock-dusted 211 mines. The tonnage annually produced by these rock-dusted mines represents approximately 11 percent of the annual production of all bituminous mines in the United States.

In many states additional credit for rock-dusting has been allowed by the workmen's compensation rating bureaus. Consequently, a great number of mines are now rock-dusting in order to obtain this reduction in insurance, in addition to the greater safety furnished by this explosion prevention measure.

The data collected during this investigation have proved that rock dusting which is the only known effective means of extinguishing a coal-dust explosion, initiated on fire damp or pure coal dust, is not to be regarded as a serious additional expense.

In addition to its value in stopping mine explosions, rock dusting has other advantages. Rock dust, particularly limestone dust, applied to the walls of mine passages readily reflects light and vastly increases the illumination afforded by the miners' light. Many accidents in mines are directly attributable to improper illumination.

The incombustile character of rock dust may be utilized in fighting mine fires. Certain mine operators consider that it has value for that purpose and are storing material at strategic points for fire fighting.

Further information is given in Bulletin 18, Coal-Mining Investigations series, "Methods and Costs of Rock-Dusting Bituminous Coal Mines," by C. W. Owings, assistant coal mining engineer, U. S. Bureau of Mines, and C. H. Dodge, research fellow, Carnegie Institute of Technology. Copies of this bulletin may be obtained from Carnegie Institute of Technology, Pittsburgh, Pa., at a price of $1.50.

MAJOR PROBLEMS IN COAL MINE VENTILATION

A Practical Discussion Of Six Major Problems In Mine Ventilation, Including Volume Of Air, Mine Resistance, Airways, Distribution Of Air, Ventilating System And Fan Installation, With Recommendations For Their Simplification

By W. J. MONTGOMERY *

IN THE discussion of this subject from the position of a mine fan manufacturer it is possible to place too much emphasis on the equipment necessary to produce the ventilation rather than taking care of the factors beyond the ventilating equipment. In fact, most of the important problems are within the mine itself. In the manufacture and sale of mine fans it is not only necessary to be thoroughly conversant with the product manufactured but it is essential to have a practical knowledge of the problems encountered in the ventilation of mines. Many inquiries for mine fans are sent out to manufacturers specifying a certain volume of air without the least knowledge of the conditions under which the ventilating equipment is to operate. It is imperative for the purchaser to make a study of his ventilation conditions and give the mine manufacturer some tangible data upon which to base his specifications.

The major problems may be summed up broadly under about six headings, namely, volume of air required, mine resistance or more commonly known, water gauge against which the fan is to operate, airways, distribution of the air, system of ventilation, and the fan installation.

The first to consider is the volume of air required. The several states have different requirements and there are provisions attached to the laws which makes the volume rather an indefinite quantity. A common figure used is to provide 100 cu. ft. for each man and 550 cu. ft. for each mule in non-gaseous mines and practically double this amount for gaseous mines. However, there is a provision usually inserted in the mining laws, that a sufficient amount of air must be provided to put the mine in a safe and sanitary condition, all as required by the mine inspector. There is no definite understanding relative to the ventilation of mines as to what constitutes a sufficient quantity of air and many operators figure vastly on the safe side. It is this practice which causes them to purchase a fan twice the capacity needed for the ventilation and sometimes twice the capacity of the mine itself, and consequently, to operate the ventilating equipment at a great loss in power consumption. It is not only this loss of power which must be taken into consideration but a high velocity through the airways greatly endangers the safety of the mine. A thumb rule which will apply for average estimating purposes for the ventilation of mines is to compute the number of square yards exposed to ventilating current in the mine and then double this item and call it cubic feet per minute. To this item must be added for the average mine 150 cu. ft. per man and 750 cu. ft. per mule. As an example, it is found that a mine contains about 50,000 sq. yds. exposed to the ventilating current and 250 men are employed and 10 mules. The problem then resolves to the simple calculations as follows: (50,000 x 2) plus (250 x 150) plus (10 x 250) equals 145,000 cu. ft. per minute.

Mr. Montgomery believes that the major ventilation problems may be overcome through installation of mechanically efficient, fire-proof and ample capacity fans, if proper attention is given to air velocity, overcasts and abandoned workings. He advocates elimination of stopping wherever practicable and where necessary, that they should be built air-tight and so constructed as to eliminate danger of being blown out in case of explosion. He advocates district rather than continuous current ventilation and believes that tracks should be maintained in main airways. He emphasizes as highly important necessity of not exceeding 3-in. pressure to ventilate a mine on every day duty.

The above data should take care of at least 35 percent loss through stoppings, doors, etc., but many of the older mines today do not show 50 percent of the air effective at the working faces. In fact, a careful survey of a total of 16 mines made by the United States Bureau of Mines showed an average of less than 20 percent of the air delivered to the mines reached the last cross cuts. Due to this great loss in the ventilating currents, the indiscriminate use of cross cuts between the intake and return should be avoided as far as possible.

After having determined the quantity of air required, the next problem is how to get this volume through the mine and this brings us up to the mine resistance or water guage developed by the passage of the air through the mine workings. This is the most important factor of mine ventilation. It is absolutely useless to provide a fan with a large capacity unless provisions are made inside the mine to pass the air but this part will be treated later on under "airways."

There is no reliable coefficient of friction given for the mine resistance. Every mine has a different rubbing surface and different turns in the airways, all of which tend to complicate any calculations. It is much better to assume that no mine should get into a condition requiring over a 3-in. water gauge to properly ventilate it on every day duty. If this pressure is reached and additional air is required, it is time to make improvements inside the mine rather than speeding up the fan for increase in pressure to produce the required volume.

It is very interesting to note at many mines, there is a prevailing opinion that a watchful eye must be kept on the water gauge to detect falls or restricted airways but this observation alone is not sufficient to insure against this occurence. Our modern fans today, when operating at a constant speed, produce, practically speaking, a constant pressure, therefore the entire closure of the airway will not have any appreciable effect on the gauge reading. It is all right to watch the gauge but, at the same time both eyes should be kept on the volume of air passing through the workings. It is surprising to find new mines, probably of two or three years' development, offering a resistance of from two to three inches gauge, whereas one-half inch should be suffiicent for the short travel and small volume passed.

It is the writer's opinion that there is a woeful lack of knowledge relative to the use of water gauge. Many operators believe that the gauge is a function of the fan and not of the mine but this is an erroneous idea. The water gauge is a measurment of the resistance offered by the mine to the passage of the air through its workings. The fan is simply a machine to produce sufficient pressure to force the air through the workings and has nothing in common with the mine resistance or commonly called water gauge. In other words, if it requires 2 pressure for a certain volume of air with the crudest type of mine fan, it will require exactly the same pressure for the same volume using the most modern fan.

* Mine Ventilation Engineer, Jeffrey Mfg. Company, Columbus, Ohio.

Westinghouse Institutes Prime Mover Sales Department

Effective January 1 the Prime Mover Sales Activities of the Westinghouse Electric and Manufacturing Company will be conducted by a new sales organization to be located at the South Philadelphia Works. This announcement was made by E. D. Kilburn, Vice President and General Sales Manager of the Westinghouse Company.

The personnel of this new department will include the following appointees:

Howell Van Blarcom, formerly assistant to the manager of the Power Department at the South Philadelphia Works, to Manager of the Prime Mover Sales Department. R. E. Carothers, formerly manager of the Steam Division of the Power Department at the East Pittsburgh Plant, to assistant Manager of this new Department. A. H. Ganshird, formerly of the large turbine section East Pittsburgh Plant, to Manager of the large turbine section of the Prime Mover Sales Department. C. G. Ong, formerly of the Central Station Division, Boston Office, to Manager of Small Turbine Section of the Prime Mover Sales Department. P. L. Fetzer, formerly of the condenser section, East Pittsburgh, to Manager of Condenser Section of the new Department.

S. L. Nicholson Appointed Vice-President Westinghouse Electric and Manufacturing Co.

At a recent meeting of the executive committee of the Westinghouse Electric and Manufacturing Company, S. L. Nicholson was elected acting vice-president.

Mr. Nicholson, a native of Philadelphia, began his electrical career in 1887, being associated with various companies from that date until 1898, when he joined the Westinghouse Company.

In 1909 Mr. Nicholson was made sales manager of the Westinghouse Company and held that position until 1917, when he was made assistant to the vice-president.

Mr. Nicholson assisted in the formation of and was the first president of the American Association of Electric Motor Manufacturers, which is now known as the Electric Power Club, and he also assisted in the formation of the American Gear Manufacturers' Association and the Stoker Manufacturers' Association. He was chairman of the Electrical Manufacturers' Council, which is the coordinating committee of the Power Club, Electric Manufacturers' Club, and the Association of American Manufacturers of Electrical Supplies. In 1921 he was chairman of the tariff committee of the council and represented the electrical industry on the National Industry Conference Board. He is also a member of the Electrical Safety Conference, the American Statistical Association, and the Bureau of Personnel Research for the Carnegie Institute of Technology.

Westinghouse Cleveland Manager Made Head of Detroit Office

John Andrews, Jr., formerly manager of the Cleveland branch office of the Westinghouse Electric and Manufacturing Company, has been made manager of the Detroit district office, effective January 15. He succeeds C. C. Owens who has resigned.

As manager of the Detroit office Mr. Andrews will be responsible for the sale of Westinghouse apparatus in nearly all of Michigan and a part of Ohio.

The new manager is a native of Pittsburgh, Pa., where he entered the employ of the Westinghouse Company in 1909. His first work with Westinghouse was in the furthering of the use of electric power in industry this being the function of the central station division to which he was attached. Later he was transferred to the general industrial division and after two years in this work was again transferred this time to the coal mining section. He continued his work in this division until September, 1917, when he was made industrial division manager of the Pittsburgh office.

In March, 1922 he was transferred to the Cleveland office as branch manager, where he has remained until his present promotion.

"General Electric's Position in the Electrical Industry" is the subject of the quarterly statement to the stockholders of the company, issued by President Gerard Swope under date of January 15, 1926. This statement is an answer to the charges that the General Electric Company is a monopoly. It clearly and definitely states the connections of the company with other electrical manufacturers, with power companies, and with financial interests.

Dr. R. B. Moore, formerly Chief Chemist of the U. S. Bureau of Mines, and now General Manager of the Dorr Company, who was largely responsible for the development of helium production during the war, was presented with the Perkin Medal for 1925 at the Chemists' Club on January 15th.

The medal is given by the American Society for Chemical Industry, and the selection is made by a committee from that organization, the American Chemical Society, the American Institute of Chemical Engineers and the American section of the Societe' de Chimie Industrielle.

Changes in the Organization of Link-Belt Company

For some time it has seemed advisable to the management of the Link-Belt Company to create a new position —that of Chief Engineer of the company.

This new position carries with it the responsibility of general supervision over all engineering work, harmonizing the practice of their several plants, and following up new engineering development.

The position is being filled by W. W. Sayers, formerly Chief Engineer of the Philadelphia plant. His new headquarters will be at the general office address, 910 S. Michigan Avenue, Chicago.

It is said that Mr. Sayers is admirably fitted for his new and important duties. He graduated from the University of Illinois in 1897 and, in his 23 years of Link-Belt experience, has successfully held many important positions in the engineering construction and sales departments of the company.

George L. Morehead, for the past 6 years attached to the management of the several Indianapolis plants, and who has made an enviable record for himself there, as well as at the Link-Belt Chicago plant, takes on the duties of Manager of the Philadelphia plant.

Mr. Morehead graduated from the University of Missouri in 1902 and has been with Link-Belt Company for the past 19 years. In these active years he has successively held the positions of Maintenance Engineer, Superintendent of Construction, and Assistant Chief Engineer of the Chicago plant; Assistant Manager of the Link-Belt Indianapolis organization; and then Manager of their Ewart Works and Belmont Works, both located in Indianapolis.

The Link-Belt Company has announced the opening of a branch office in the First Wisconsin National Bank Bldg., Milwaukee, Wis., with Mr. R. C. Kendall in charge.

This step has been taken as a result of their constantly-growing volume of orders for Link-Belt Silent Chain Drives for the transmission of power.

Changes in Executive Personnel of the Timken Roller Bearing Company

The Timken Roller Bearing Company, Canton, Ohio, announces the appointment of Ernest Wooler as Chief Engineer. For the past year Mr. Wooler held the position of Automotive Engineer. His present position puts him in full charge of all Automotive, Industrial, Experimental and Service Engineering. Mr. Wooler, an Englishman by birth, has had experience in both American and European engineering and manufacturing practices, which well

qualifies him for the important position he is now about to fill.

Other changes in the executive personnel of the Timken Roller Bearing Company include the promotion of J. W. Spray to the position of Manager of Sales, Automotive Division.

E. W. Austin has been promoted to the position of Assistant Manager of Sales, Automotive Division. Mr. Austin began work with the Timken company in 1919 as an automotive salesman. He was promoted to the position of District Manager with offices in Cleveland. These offices will be maintained as in the past. No change will be made in Mr. Austin's territory. Sales work in the Eastern territory will be under his direction.

R. W. Ballentine has also been made Assistant Manager of Sales, Automotive Division. Mr. Ballentine came with the company in 1916 as an automotive salesman. Later, he was advanced to the position of District Manager with offices in Milwaukee. These offices will be maintained, affording easy access to manufacturers in this territory.

Peter C. Poss has been made Assistant Advertising Manager. Mr. Poss has been in the advertising department of the Timken Company at Canton since joining that organization. He was formerly with the Penton Publishing Company of Cleveland.

E. M. Staehle, formerly in charge of industrial advertising for the Westinghouse Electric and Manufacturing Company, East Pittsburgh, has resigned to become Eastern representative of the Keystone Mining Catalogs. Mr. Staehle, who succeeds Edward B. Day, will have his headquarters at the offices of the McGraw-Hill Company, Tenth avenue at Thirty-sixth street, New York, which recently acquired the Keystone catalogs and directories.

Mr. A. D. Hughes has joined the staff of the Ludlum Engineering Company, 2 Rector Street, New York City. This company contemplates extending its activities in the placer fields and Mr. Hughes has been placed in charge of the work in this direction. Mr. Hughes has just returned from an inspection trip to the property of the Guatemala Gold Dredging Company in Central America. The prospecting work for this successful company was originally done by the Ludlum Engineering Company's staff.

The Griscom-Russell Company has announced the removal of its general offices to the new Murray Hill Building at 40th Street, 285 Madison Avenue, New York City.

General Electric Orders For 1925

Orders received by the General Electric Company for the year ending December 31, 1925, amounted to $302,513,380, according to an announcement by Gerard Swope, president of the company. Compared with $283,107,697 for the year 1924, this was an increase of 7 percent.

For the three months ending December 31, 1925, orders totalled $78,636,669, compared with $80,009,978 for the same quarter of 1924, a decrease of 2 percent.

Foote Bros. Gear & Machine Company have recently received an order for a number of Spur Gear Speed Reducers for use in the new eight million dollar Municipal Water Works under construction at Kansas City, Mo.

W. C. Davis, President of Foote Bros., recently returned from a business trip through the East. He spent several days at the New York Power Show and held conferences with the New York, Philadelphia and Pittsburgh representatives of the company regarding sales conditions. The outlook for 1926 business from these sections were reported as exceptionally good. R. F. Mosedale of Buffalo, N. Y., Western New York representative for Foote Bros. Gear & Machine Co., recently visited the factory and home office. Mr. Mosedale reports excellent prospects for a large sales volume in that territory for 1926 which will even exceed the 1925 record.

The Barber Asphalt Company, main office, Philadelphia, has awarded a contract for a new branch plant unit in Buffalo to the Austin Company, Engineers and Builders, Cleveland.

At the Buffalo Works machines are built for applying asphalt products. The new building will be used as a light machine shop. It is 45x225 feet of one story steel frame type, designed for a future second floor. The Austin Company has agreed to complete the work in 35 working days. Mr. A. L. Bell is Manager of the Buffalo Works.

The Miller Rubber Company, Akron, has awarded The Austin Company, Engineers and Builders, a contract for the design and construction of a reclaiming plant to be built at Kenmore, Ohio, near Akron.

The new plant will contain close to 35,000 sq. ft. of floor space, one and three stories, of steel frame construction. An investment of $100,000 is involved. The Miller Rubber Company, through a special new process, expects to effect worthwhile economies in the reclaiming of rubber, which has become an important department of the rubber business since the recent sharp advance in the price of crude rubber.

Construction work will be rushed through to early completion. The Austin Company has agreed to complete the project by March 1, 1926. About 120 tons of structural steel will be required. Some materials will be purchased locally through the Cleveland office of the builder.

Link-Belt Issues New Book on Gasoline Crawlers

The new All-Purpose Crawler Crane Book No. 895 just issued by Link-Belt is one of the most complete ever published. The book contains 48 pages, generously illustrated to show the use of the drag-line, dipper and trench shovel, skimmer scoop, hook blocks and pile drivers.

Data on lifting capacities, approximate operating speeds, line pull, tractive effort, etc., are given. The tables in which this data is arranged have been supplemented by line drawings which show dimensions for operating limits.

Finally in a brief and interesting way, information is given on some of the usual, as well as the more ingenious uses to which the various types of cranes can be put. Link-Belt has so designed the Gasoline Crawler that it can be used with dipper shovel or any one of six different accessories, hence the name All-Purpose Crawler.

Copies of this book will be mailed free upon request to Link-Belt Company, at Chicago, Philadelphia or Indianapolis.

The Du Pont Everdur Company of Wilmington, Del., has issued an attractively printed and illustrated booklet describing in detail important facts about Everdur metal, its new product. Everdur is a corrosion-resistant alloy with physical properties characteristic of steel and was developed by the Du Pont Company to meet corrosion problems existing in some of its own operations which involved the use of hydrochloric acid, the corrosion-resistant alloys and metals available on the market not having been found sufficiently resistant to be of service for the construction of plant equipment in these operations.

In discussing the metal, the booklet states, "Further tests developed the fact that Everdur was resistant in a greater degree to a larger number of corroding agents than other corrosion-resistant alloys on the market, had a tensile strength and elastic limit considerably above acid-resistant bronzes (comparable with steel), made sound castings, possessed excellent machining and working qualities, and could be fabricated into the various forms obtainable from

steel, including wire and seamless cold drawn pipe and tubing."

The new metal is described as an alloy of copper, silicon, and manganese, of the solid solution type, which because of its homogeneity is recognized as the type of alloy most desirable for resistance to corrosion.

The booklet is full of interesting data on corrosion and the details of the resistance of Everdur to various acids. The working qualities of the metal are explained, how it is cast, how it should be melted and poured, the preparation of molds, and other information necessary for customers.

Among **General Electric Company's** recent catalogs are the following: W.D.-12 Generator, on Gas Engine-Driven Arc Welding Sets; Single Stage Centrifugal Air Compressors; G.-E. Mine Locomotive Headlights.

Circular 7381 on Electrical Drives for Power Plant Auxiliaries is a catalog recently issued by **Westinghouse Electric and Manufacturing Company.**

The **Dorr Company**, 247 Park Ave., New York, has issued a very attractive wall calendar which it will be pleased to send direct to any one interested.

ELECTROTHERMIC METALLURGY OF ZINC

A STUDY of the electrothermic distillation of zinc ores is being conducted by the Bureau of Mines, with the purpose of perfecting a process that will be suitable to conditions in the United States, in order that zinc ores may be smelted more efficiently and cheaply than by the present retort process, and that complex ores which cannot be worked profitably by present processes may be treated economically. The development of an electrothermic dry distillation zinc furnace which uses small zinc ore briquets in bulk as a resistor, instead of a built up resistor of large briquets, has been brought to a conclusion, so far as it could be with a small laboratory furnace holding a charge of about one hundred pounds of briquets, with satisfactory results. Further development of this type of furnace will depend upon the installation of a larger furnace. A complete experimental dry distillation zinc smelting plant, using the Fulton process, is nearing completion. This plant will include the necessary crushing equipment for crushing ore and coke, a hydraulic press for making the briquets, a baking oven for baking new briquets by means of the waste heat in the distilled briquets, and a three-unit distillation plant with central condenser. The plan will have a capacity of several hundred pounds of zinc per day.

1926 PROSPECTS FOR THE ELECTRICAL INDUSTRY

PROSPECTS for the electrical industry in 1926 are excellent, according to E. M. Herr, President, Westinghouse Electric and Manufacturing Company, who says "there are many factors that should exert a favorable influence on the electrical business during the coming year, which we believe will be as good as, and possibly slightly better than, the present year. One of the most important is the promise of a marked improvement in conditions in Europe, which, if realized, will benefit all American industry; another is the practical certainty of a reduction in Federal taxes, as well as the general confidence which is felt in the Coolidge Administration.

"The finances of the nation are in very satisfactory shape, and industrially the country is very active, especially in the steel and building trade. Other encouraging factors are the splendid showing of the railroads and the general improvement in the economic position of the farmers, resulting from the excellent crops during the present year and the optimistic crop reports of the Government for 1926.

"The movement for the elimination of waste in industry is beginning to bear fruit and promises to be a factor of constantly increasing importance in our prosperity as a nation.

"In the electrical industry, considerable development is anticipated in the coming year. It is estimated that the increase in the production of electrical energy will be approximately 500,000,000 kilowatt hours, or 10 percent more than the present total output; the purchasing power of the industry is estimated to be about $700,000,000.

"There is an increased demand for electrical energy for refrigeration and for industrial heating. For the latter application alone it is believed that at least 400,000 kilowatts of current will be needed during the coming year.

"In the steel industry electric drive is recognized as one of the important factors in economy of operation. During the past year steel companies made extensive electrical installations and it is anticipated that as business improves the use of electricity will be still further extended.

"The coal industry, now the largest consumer of electric power, will continue to offer a large market for electrical apparatus.

"The comparatively recent recognition of the value of electricity in the oil industry, together with improved economic conditions in that field, forecast considerable purchases of electrical apparatus. This industry, one of the last of the major industries to realize the value of electrification, is only about 5 percent electrified at present, whereas such industries as steel and coal are from 60 to 80 percent electrified.

"There is every reason to believe that in 1926 the market for large electrical generating and distributing apparatus will show a marked improvement over 1925. In 1923 there was unusually heavy buying of such apparatus but since then purchases of the large Public Utility Companies have been below normal. One of the most serious conditions with which the electrical industry is faced today is the intermittent demand for large capacity electrical apparatus, involving heavy capital expenditures. This results in a disturbance of labor conditions in the shops where such apparatus is manufactured and makes impossible a uniform production schedule.

"A somewhat parallel condition exists in the purchase of supply apparatus by Public Utility Companies. During the first half of the year the demand for this product is about 20 percent greater than during the last half. A more uniform system of buying throughout the year would certainly result in a more efficient utilization of man-power, manufacturing and transportation facilities, and invested capital, as well as lower prices to the consumer.

There has been a material increase in the use of electrical household appliances during the year 1925 and a still further increase is anticipated in 1926.

"In the radio field the most noticeable tendencies are toward improvement in the quality of broadcasting and a demand for receiving apparatus of better tone quality. Apparatus regarded as entirely satisfactory a short time ago is now considered very inferior from a quality standpoint. This will bring about an increased demand for radio apparatus.

"Summing up, the electrical industry is still in its infancy, and its future looks very bright; only about one-third of our homes are today using electrical devices to any marked extent; the electrification of rural districts has hardly begun; railroads are just beginning to electrify. The present amount of undeveloped water power about equals the combined capacity of our existing electric power systems and there are great possibilities in the rapidly progressing program of power system interconnection. As the per capita use of electricity has doubled every five years, the demand should continue for years to come, with the ordinary fluctuations due to economic conditions throughout the country."

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ACETYLENE GENERATING APPARATUS

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Hercules Powder Co., 934 King St., Wilmington, Del.

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Hercules Powder Co., 934 King St., Wilmington, Del.

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CAGES

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CARBON RODS AND PASTE FOR WELDING

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
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CHAINS, DRIVE

The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
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CHAINS, FRONT END

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Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING

Morse Chain Co., Ithaca, N. Y.

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Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CHAINS, SILENT (Rocker-Joint)

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CHAINS, SLING

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Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

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Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.
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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL SCREENS

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COMPRESSORS, MINE CAR

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CONCENTRATORS (Table)

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT

American Steel & Wire Co., Chicago and New York

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To construct a welded storage tank successfully requires much more than skilled workmanship, although this is highly essential. Sound metal, efficient equipment, proper design and preparation of the joints, intelligent inspection and adequate testing all play an important part. The Linde Procedure Control on welding a storage tank gives detailed information on all necessary points.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

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CONVEYORS, SCREW
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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
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Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

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CRUSHING PLANTS, COKE
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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42nd St., New York City.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

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Hoffman Bros., Punxsutawney, Pa.

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DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DOUBLE CRIMPED WIRE SCREENS
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H. R. Ameling Prospecting Co., Rolla, Mo.
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Morse Chain Co., Ithaca, N. Y.

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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

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Hercules Powder Co., 934 King St., Wilmington, Del.

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General Electric Co., Schenectady, N. Y.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC MINE SUPPLIES
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ELECTRICAL SUPPLIES
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GEARS, REDUCTION
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GEARS, HERRINGBONE
Fawcus Machine Co., Pittsburgh, Pa.
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GEARS, SPUR
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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

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GOGGLES, WELDING
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Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

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Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

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HOSE, WELDING
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INSULATORS, SECTION
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Porcelain)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Third Rail)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

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General Electric Co., Schenectady, N. Y.

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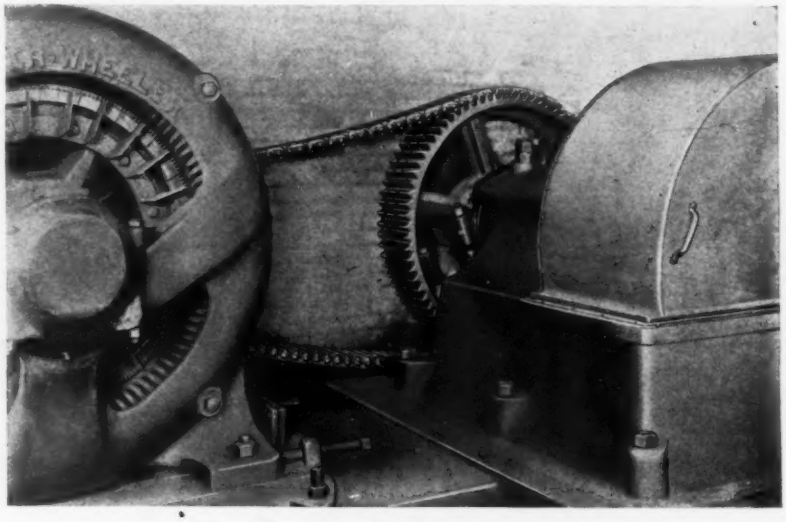

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